ENGIN STORAGE
TN 67 ENGINEERING
B53 v.8 no.7
Physical & Applied Sci.

Member of the Audit Bureau of Circulations.

The Blast Furnace and Steel Plant

Pittsburgh, July, 1920.

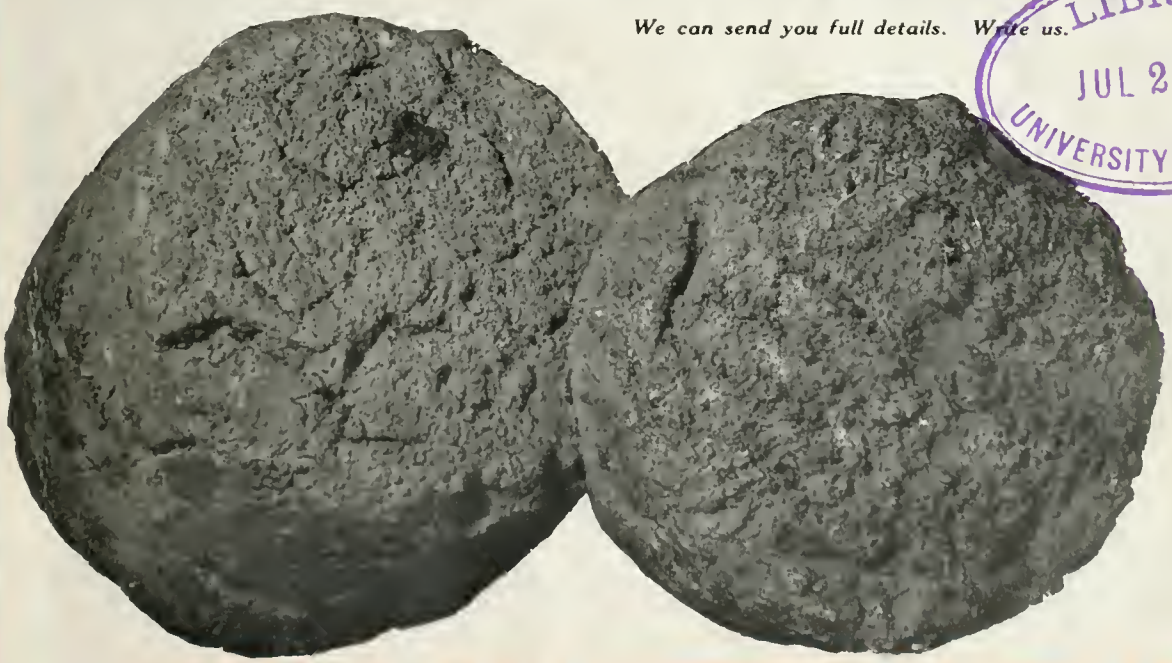
What are You doing with Your Flue Dust?

Do you know that at a very low cost—whether it is **Dry Dust, Wet Pulp or Filter Dust**—it can be returned to the furnace in the form of **Briquettes**, and successfully smelted?

The **Schumacher Briquette** should interest you.

The plant for this briquetting is simple, low in first cost, low in operating cost. It requires no fires, no heating, no highly skilled labor, little technical supervision. The briquettes are strong, handle well and hold together in the furnace until fully reduced.

We can send you full details. Write us.


IRON
These were Flue Dust Briquettes they went through the stove heat with a burden on them. They were reduced to metal. We show these to the man who claims briquettes disintegrate in the blast furnace. He has no answer for there is none.

GENERAL BRIQUETTING COMPANY

25 BROAD STREET, NEW YORK

Consulting Engineers

Briquetting in all Its Phases.

WE ALSO MANUFACTURE PRESSES FOR THE BRIQUETTING OF METAL CHIPS AND TURNINGS.

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CLARK CARS

EXTENSION SIDE DUMP

Reduce Labor Costs in handling waste materials

Clark Cars dump anything dumpable—

One car at a time or all cars at once—

Leaving a clear track—no after clearing.

Unobstructed discharge—no back fill.

Standard railroad cars in every way—

Plus automatic Dumping that
Puts labor back on productive work.

Steel mills use and approve them.

Why pay out many times their purchase price in wages to hand labor?

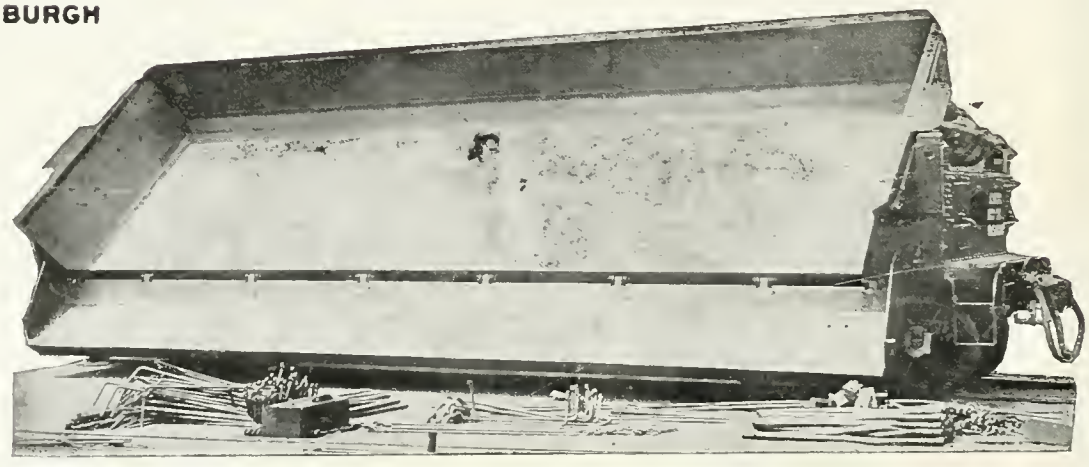
Tomorrow's production costs may depend on your action today. You'll find us ready.

CLARK CAR COMPANY

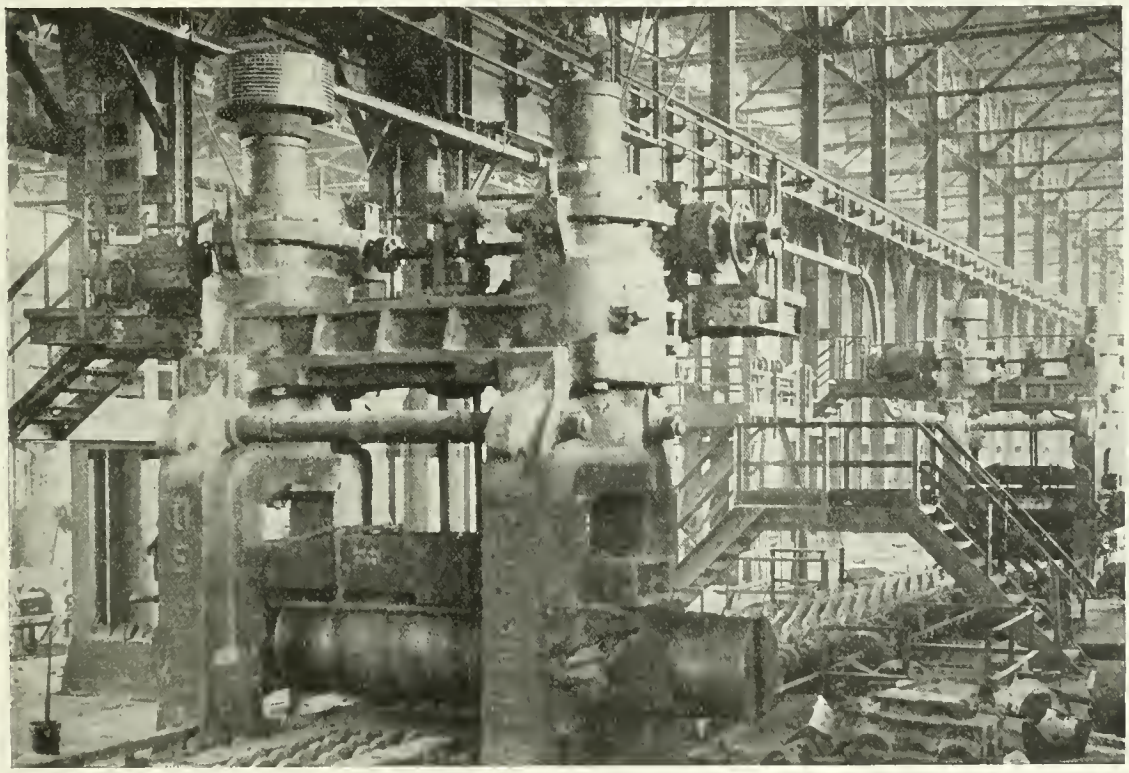
PITTSBURGH

Chicago—Peoples Gas Building.

PITTSBURGH



"UNITED" ROLLING MILL EQUIPMENT



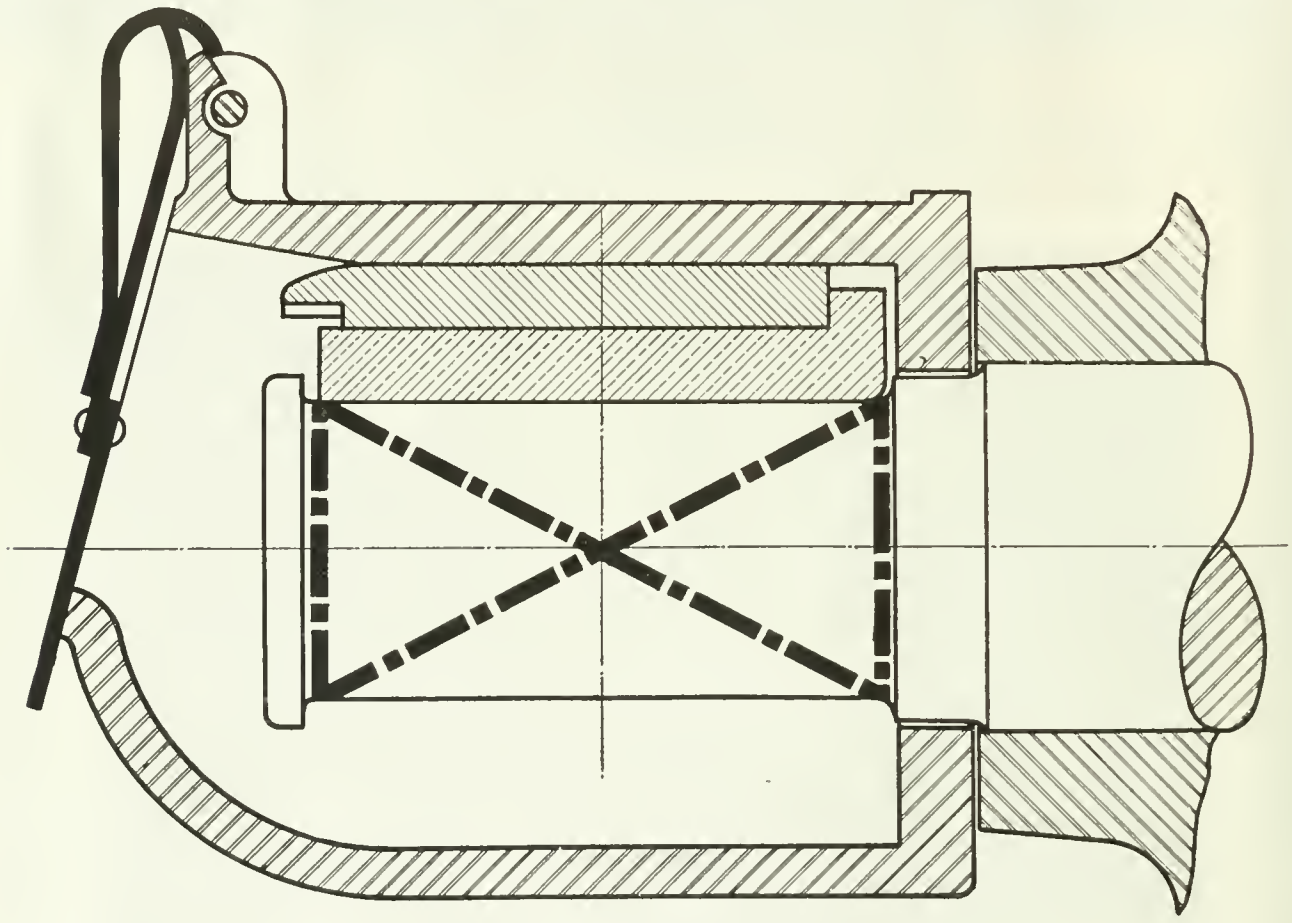
84" Plate Mill at the Brier Hill Steel Company. The roughing stand is shown in the foreground with the finishing stand in the distance.

UNITED ENGINEERING & FOUNDRY CO
PITTSBURGH, PA.

The World's Greatest Manufacturers of Rolls and Rolling Mill Machinery.

Co-operate:—Refer to The Blast Furnace and Steel Plant

THE OLD CROSSED LINES



Here's a drawing of an old fashioned steel mill car journal box. If your design shows two diagonal lines, ordinary bearings are represented—no thought has been given to the uncertainty of operation, to the frequent oiling which will be needed, to the stiff cars that will be so hard to move during the winter months.

Bearings are not just details of a steel mill car—they are very vital parts and very careful consideration should be given to them.

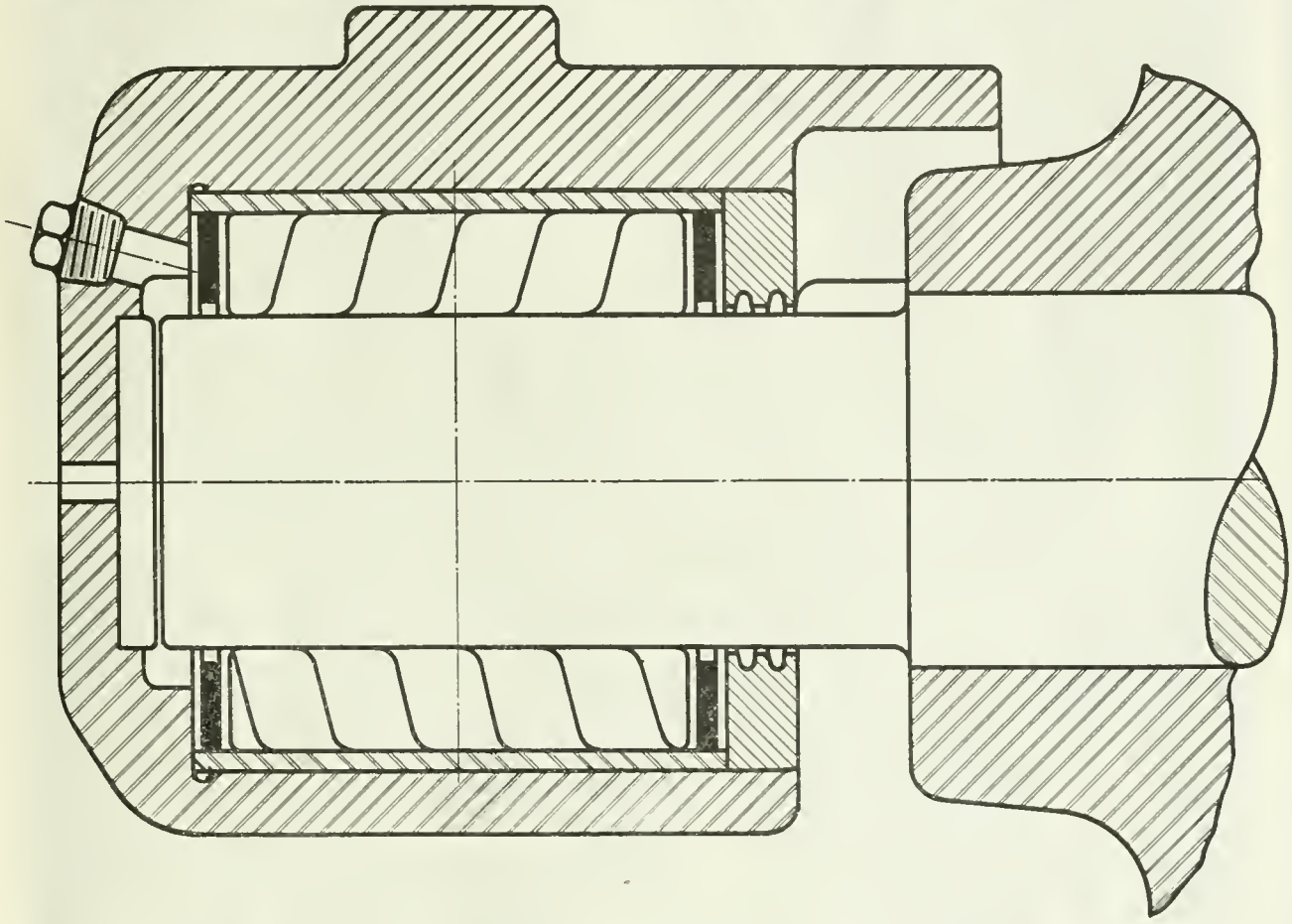
Progressive steel mill engineers who know the many advantages of Hyatt equipped cars are changing over their cars this summer. They will be in fine shape to keep the steel moving constantly next winter and for years to come.

Don't continue to order plain bearing cars just because the old designs show them—specify Hyatt Roller Bearings.

HYATT BEARINGS

Co-operate:—Refer to The Blast Furnace and Steel Plant

VERSUS MODERN BEARINGS



This drawing shows a Hyatt Roller Bearing steel mill car journal box—a modern journal box. If your design specifies Hyatt Roller Bearings you are using sound judgment.

Many large steel mills have changed their car designs to incorporate Hyatt Roller Bearings and have worked out a method whereby their ordinary cars can be changed over to Hyatt Roller Bearing cars.

At the Bellaire Works of the Carnegie Steel Company they change over fifteen cars every two months, and now have ninety cars in operation. At the Farrel Works of the same company they change ten cars at a time and now have one hundred and five cars in operation.

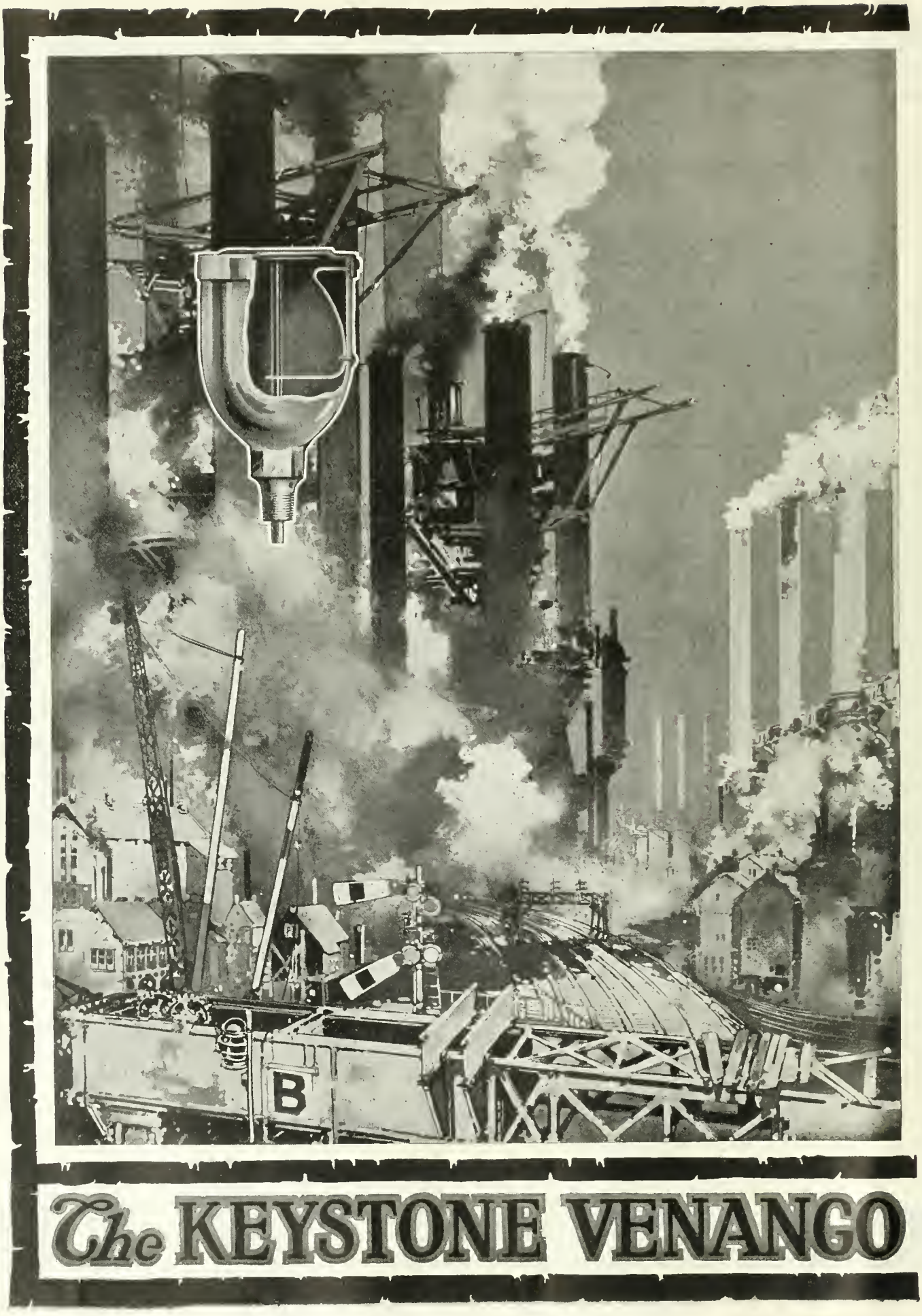
This is a logical method for you to follow in putting your cars on a dependable basis.

Write to the Hyatt Roller Bearing Company, New York, N. Y., for complete engineering data on car and table designs. 1807

Hyatt Roller Bearing Co., Industrial Bearings Division, New York, N. Y.

FOR STEEL MILLS

Co-operate:—Refer to The Blast Furnace and Steel Plant



Co-operate:—Refer to The Blast Furnace and Steel Plant

Famous for Its Efficiency, Economy and Ease of Operation

EVEN under extraordinarily severe working conditions the Keystone Venango Gravity Grease System renders a degree of service far greater than that to which the average crane operator is accustomed.

Those in charge of lubricating many of the largest cranes in the world agree that in the elimination of shutdowns and costly repairs alone, the Keystone Venango Gravity Grease System effects a total saving of thousands of dollars annually.

Why not arrange for a trial installation at our risk.

The Keystone Lubricating Company

New York
Boston
Pittsburgh
Chicago

Executive Office and Works:
PHILADELPHIA, PA.
Established 1884

St. Louis
Denver
San Francisco
Minneapolis
Houston

Continental European Office, Marseilles, France

India, Calcutta, Bombay
Norway, Christiania

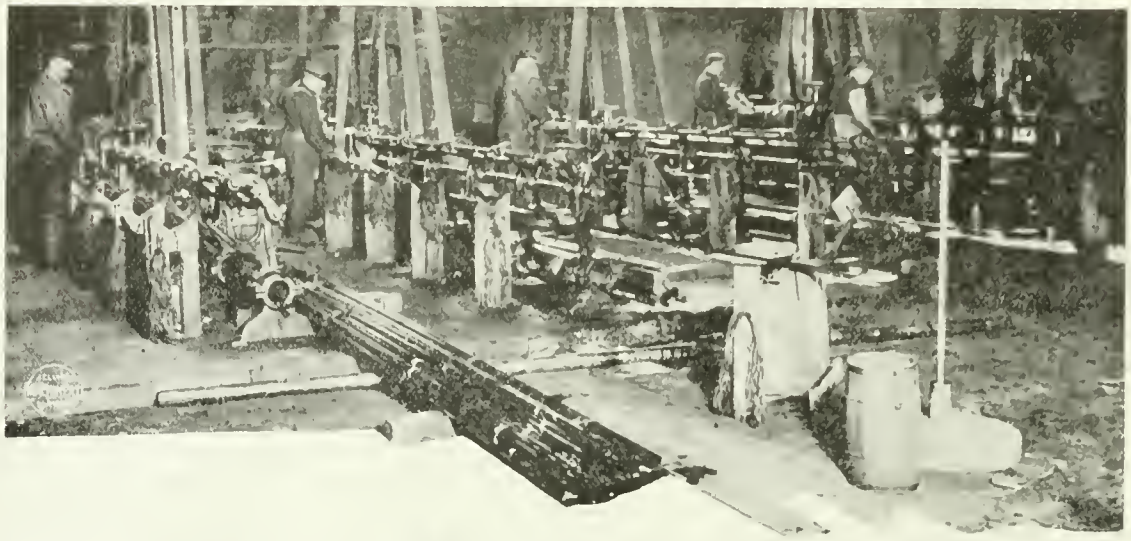
Italy, Turin
Egypt, Cairo
Japan, Tokio

Jamaica, Kingston
Denmark, Copenhagen

KEYSTONE
TRADE MARK
Reg. U.S. Pat. Off.
GREASE

GRAVITY GREASE SYSTEM

Co-operate:—Refer to The Blast Furnace and Steel Plant



"What Other Machine Could We Use?"

There are Seven Shuster Wire Straightening and Cutting Machines in this Plant

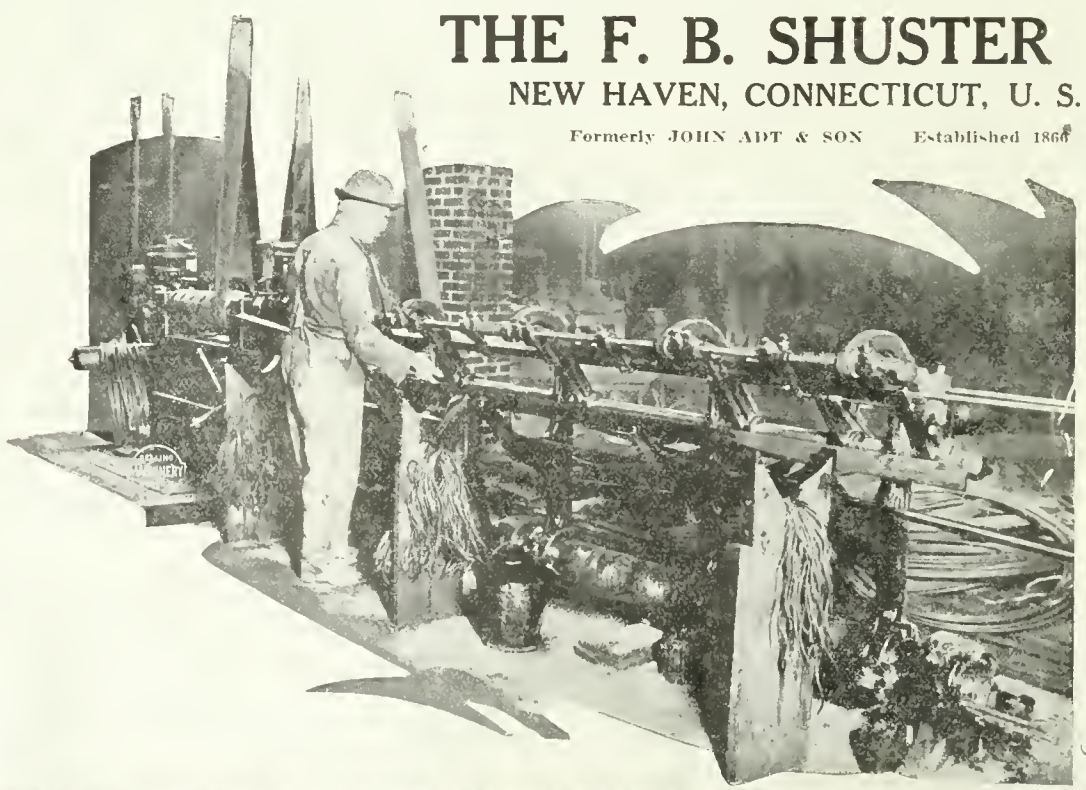
Seven was the perfect number to the ancient Chaldeans; seven looks pretty good to this Middle Western Drawn Steel Company too—seven Shuster Straighteners and Cutters that is. They have one ¼" machine, two ⅜", two ⅝" and one ¾" machines for round stock and one ½" for hexagons. All of them are used constantly and some idea of the output may be obtained from the ½" machine, which puts through 12,000 lbs. of hexagon stock and the ¾" machine which puts through 10 tons of round wire daily. It was the manager who made the remark quoted above—and he added that "Seven Shusters will be just about perfect—until we need more."

For full information on Shuster Machines for rounds, squares, hexagons and flats—send for Catalogue R

THE F. B. SHUSTER CO.

NEW HAVEN, CONNECTICUT, U. S. A.

Formerly JOHN ADT & SON Established 1866



Co-operate:—Refer to The Blast Furnace and Steel Plant

Gulf Service

¶ Maintaining an efficient corps of skilled lubricating engineers, we are at all times ready to be of assistance in the solution of your lubrication problems.

¶ Our engineers will visit your plant by appointment, fully prepared to study your needs. A postal will suffice.

GULF LUBRICANTS and GREASES
for Gears and Cables

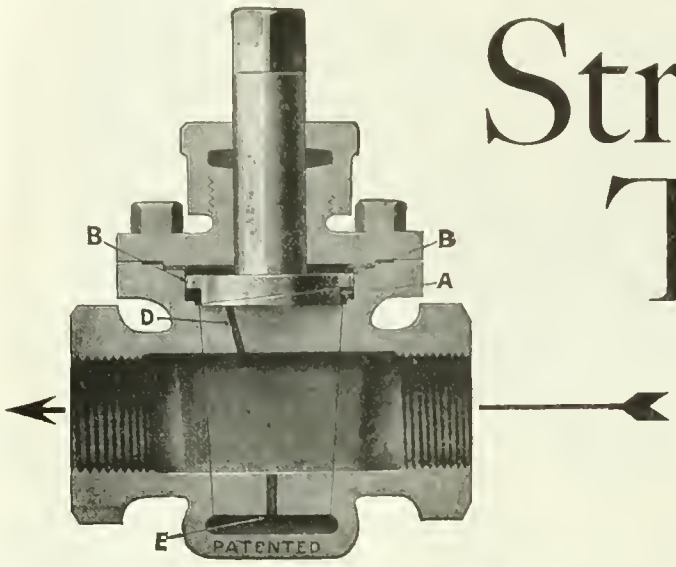
GULF REFINING COMPANY

General Sales Offices, PITTSBURGH, PA.

District Sales Offices:

New York	Philadelphia	Boston
Atlanta	New Orleans	Houston

Co-operate:—Refer to The Blast Furnace and Steel Plant



Straight Through!

A path as straight as an arrow with no projections or pockets. A clear full pipe area smooth walled opening is presented to the flow.

HOMESTEAD
QUARTER-TURN VALVE

Just compare this to the resistance offered by the many turns made in a globe valve, or to the retarding effect of the pocket in a gate valve. Both mean pressure loss and inefficiency.

Homestead Quarter Turn Valves are opened or closed by a quarter turn of the handle.

The seating surface is entirely protected while the pressure is passing through. Wire drawing and scoring is eliminated.

The wear is extremely slight and automatically compensated for by a patented traveling cam which forces the plug downward in seating.

That is why Homesteads stay tight and cost much less to maintain than other valves.

Try a Homestead Where You Have Had a Globe or Gate and Watch the Results. Made in all sizes in straightway, three-way and four-way patterns for pressures up to 5,000 lb.

Send us an order today.

Homestead Valve Manufacturing Co.
Homestead, Pa.

New York Office: 242 Lafayette St., New York City

Have You Ever Watched a TOLEDO Operate?

If you could see the above Toledo Crane in operation at the plant of the Parish & Bingham Co., Cleveland, O., you would see real crane service. Sheet is the material handled here and the ease of starting and running has everything to do with keeping stock in position for stamping and shearing, never holding up production by inability to work, and its record is one of service and satisfaction.

Toledo Cranes give the most in service whether in a sheet stamping plant, rolling mill, foundry, power plant or any place material is to be handled.

A Toledo Crane represents thought, experience, care in design and are installed for exactly the kind of service your production demands. To get that built-in quality, master workmanship and years of specialization are necessary. To get these qualities the name "Toledo" on a crane is important.

Write Us for Any Information Concerning Cranes.

Toledo Bridge & Crane Company

Toledo, Ohio

TOLEDO CRANES

Noheet METAL

¶ MONEY isn't valuable of itself but only as a representative of things which it will buy. You can't eat gold or use it as clothing.

¶ So, with bearing metals: Unless you buy SERVICE every one of them is expensive, no matter what is its price.

¶ ***"Noheet"*** makes the dollar look like its old-time self. When you buy ***"Noheet"*** you get a bearing metal of proven quality at a low price. But you also get SERVICE combined with a scientific system of installation and operation that cuts your costs.

¶ And don't forget that ***"Noheet"*** die-cast bearings are the best and the most economical made—they save all machining.

Noheet METAL

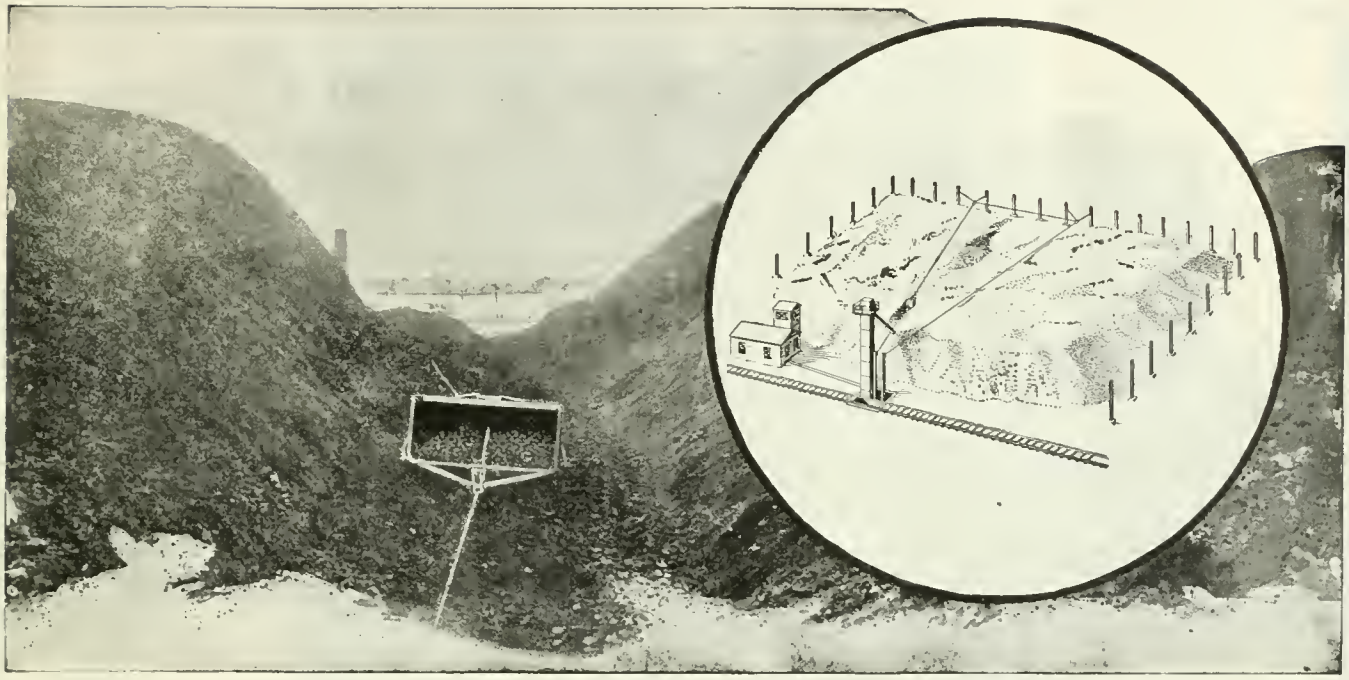
Noheet METAL

The Lubricating Metal Co.

2 Rector Street, New York

Chicago Pittsburgh Cleveland

Noheet METAL



What Would You Do With Coal—If You Could Get It?

Suppose you could get enough coal *right now* during the slack season when most railroads are in a position to transport it, to last you for months to come—could you take care of it? Have you the necessary storage facilities to handle it? The uncertainty of the future coal and transportation situations makes this question vital to all large manufacturing plants and public service corporations.

The problem is easily solved if you have storage space adjacent to your boiler house or railroad siding, *plus* a Beaumont Drag Scraper. The storage space may be any shape and cover any area. The circled illustration shows a typical Beaumont Drag Scraper installation. Coal is discharged into the hopper and elevated to a chute which piles up the coal. From there it is hauled out over the storage area by the scoops which are operated by wire cables from the machinery house. Then when this coal is needed in the boiler room, the operation is simply reversed.

Beaumont Drag Scraper systems have a capacity of 50 to 100 tons per hour and can be operated with ordinary labor at a cost of less than 1 cent per ton. The installation cost and depreciation are both low and the entire system can be easily and quickly installed, or readily moved if necessity requires. Any size of coal—lump or crushed—can be easily handled and the various sizes can be stored separately if desired. Investigation will prove conclusively that this method of coal storage is not only the most desirable but also the most economical from every standpoint.

Many valuable facts about the Drag Scraper system of coal storage are given in the Beaumont book "Cable Drag Scraper Systems for Storing Coal". It will be sent on request.

Beaumont
ONE CONTRACT ONE RESPONSIBILITY

A Few Plants Using Beaumont Equipment

U. S. Ammonium Nitrate Plant Perryville, Md.

Johns-Monsville Co. Mansville, N. J.

U. S. Aluminum Co. New Kensington, Pa.

Norfolk Navy Yard Norfolk, Va.

New York Central Railroad Utica, N. Y.

Edison Electric Light Company Lancaster, Pa.

DuPont Powder Co. Hopewell, Va. (8 contracts)

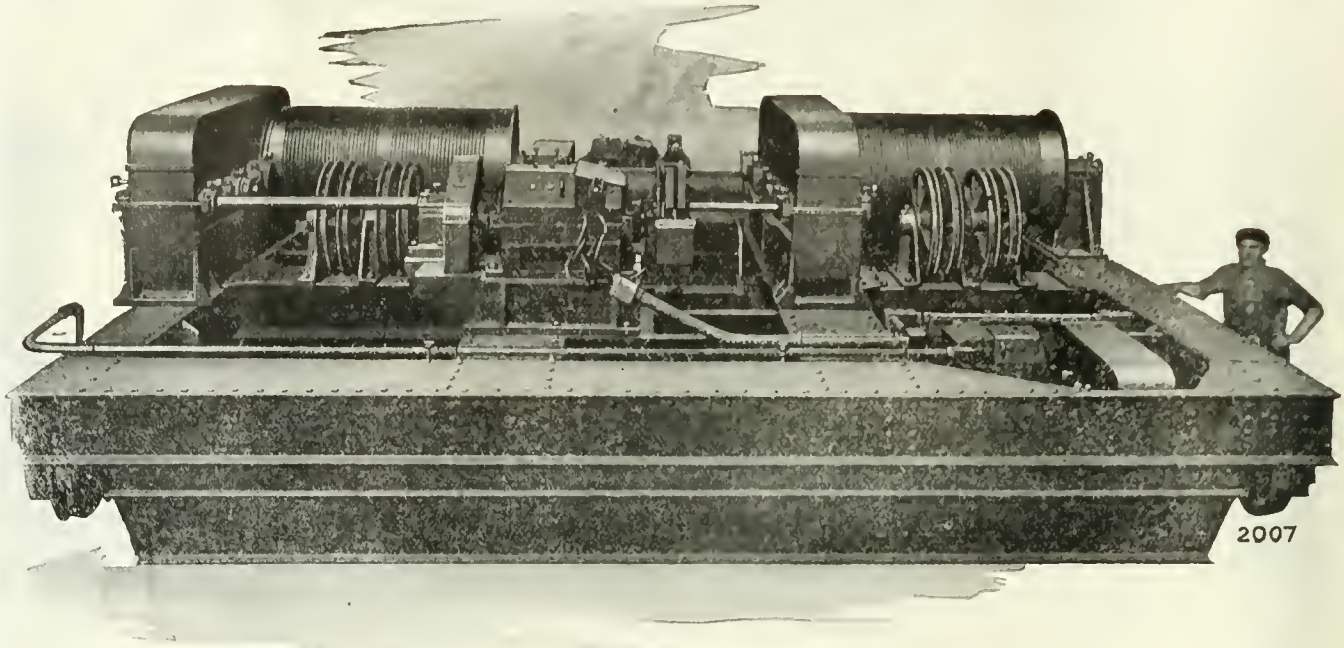
Beaumont Company specializes only on boiler houses and equipment used in their operation, and does not enter into any other kinds of engineering and construction work. It seems conservative, therefore, to claim that their organization is better qualified in size, knowledge and experience for this one class of work than any other in the country.

R·H· BEAUMONT CO·

Coal and Ash Handling Systems for Boiler Houses

330 Arch Street Philadelphia

Co-operate:—Refer to The Blast Furnace and Steel Plant



135-Ton Special Three-Motor Electric Crane Trolley with 10-Ton Auxiliary Hoist.
Two furnished Union Pacific R. R. for 250-ton locomotive-handling crane.

We Make Big Cranes Too

CRANES
Cupolas
Tumblers
Core Ovens
Converters
Ladles
Cars & Trucks
Turntables
Tramrails
Elevators
Air Hoists
Brass Furnaces
Malleable Furnaces

Locomotive Hoists
Coach Hoists
Transfer Tables
Turntable Tractors

The above is one example of some of the large cranes we have recently built. Our shop is equipped to handle cranes up to 250 tons capacity and of practically any span.

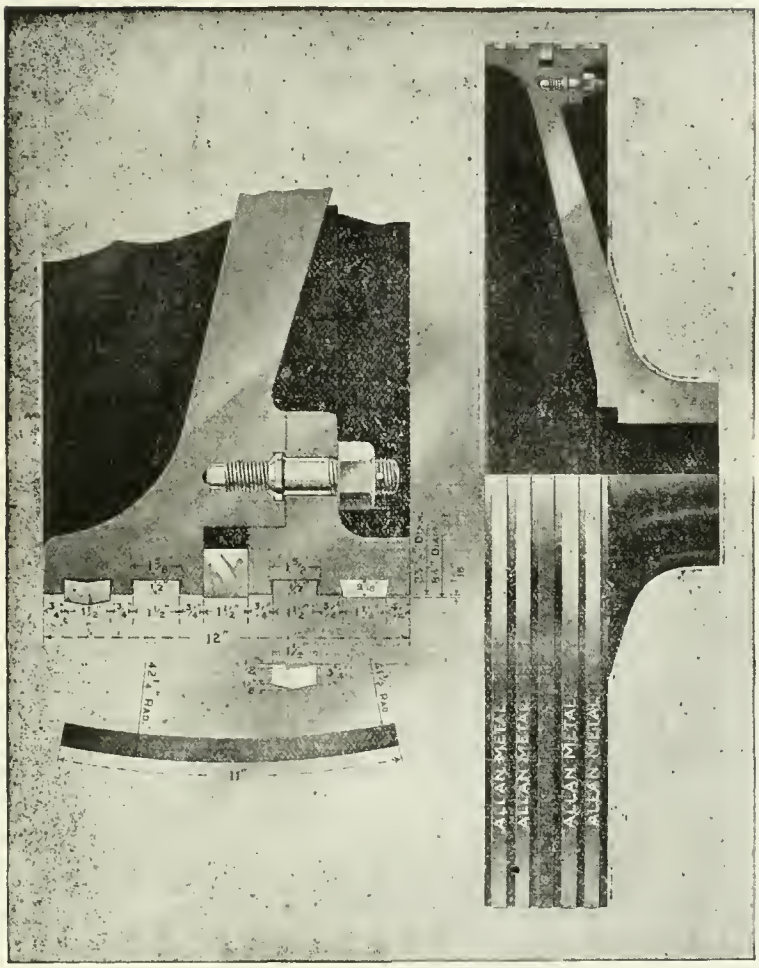
Send us your next inquiry for cranes, big or small.

Catalog No. 151 on request.

Whiting Foundry Equipment Co.
Harvey (Chicago Suburb) Ill.
Canadian Factory: Paris, Ont.
Representatives in 25 Principal Cities.

WHITING

CRANES OF ALL TYPES / FOUNDRIES EQUIPPED COMPLETE



Eliminate Friction—Prevent Scoring of Cylinders

Are your piston rods and valve stem packings giving efficient service under super-heated conditions? Have you excessive wear or scoring of cylinder walls? Eliminate your bearing troubles.

ALLAN RED METAL

is the genuine lead-copper bearing alloy. For over twenty-five years Allan Red Metal faced pistons have been accepted as the most advanced design in piston construction. Eliminates friction and prevents scoring of cylinders.

Send for our booklet "The Heart of the Engine—The Seat of Power." This particularly valuable book covers in detail the application of Allan Red Metal to pistons and shows the advantages derived thereby. Should be in every operating man's library. Write today and it will be mailed immediately upon receipt of your request.

Sole Manufacturers of Allan Red Metal, Allan Bearing Bronze.

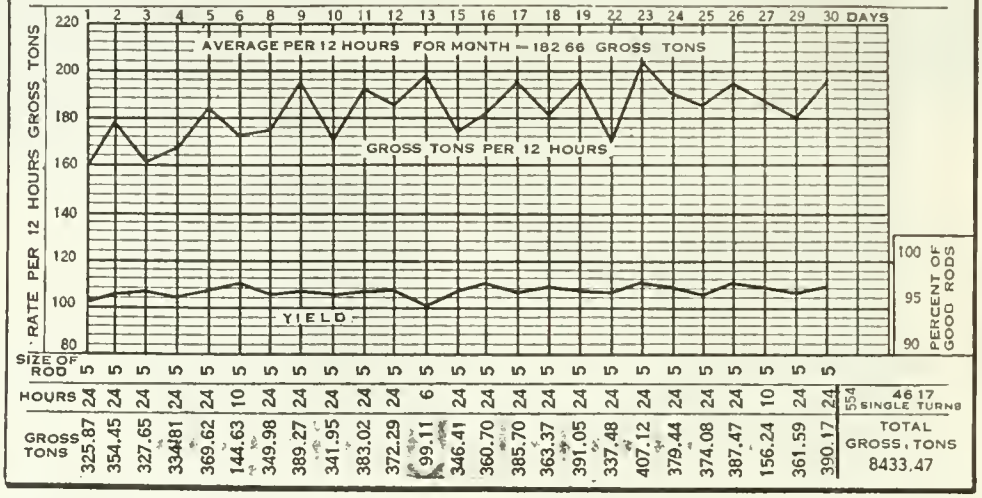
A. ALLAN & SON
HARRISON, N. J.

MORGAN
OF WORCESTER
CONTINUOUS DOUBLE STRAND ROD MILLS

M C CO

MONTHLY RECORD — APRIL 1918

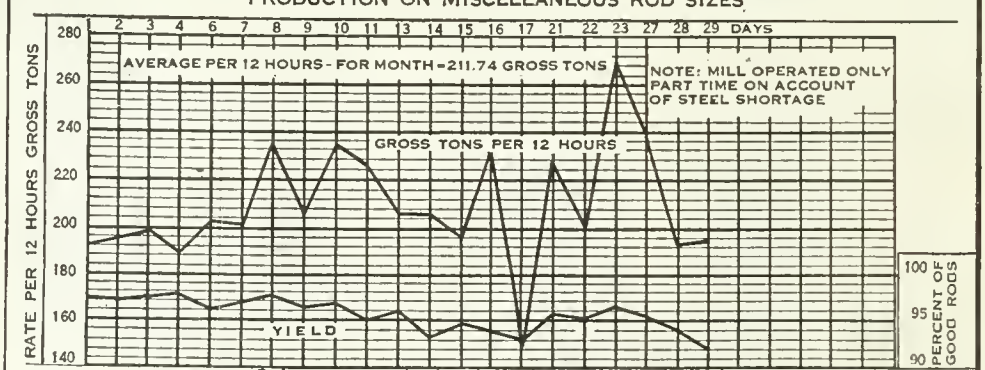
PRODUCTION ON No. 5 RODS


AVERAGE PER 12 HOURS FOR MONTH = 182 66 GROSS TONS
GROSS TONS PER 12 HOURS
YIELD
RATE PER 12 HOURS GROSS TONS
PERCENT OF GOOD RODS
DAYS

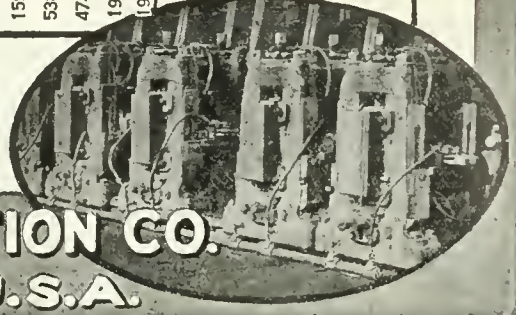
SIZE OF ROD	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
HOURS	24	24	24	24	24	10	24	24	24	24	24	6	24	24	24	24	24	24	24	24	24	24	24	10	24	24	554	46 17 SINGLE TURNS
GROSS TONS	325.87	354.45	327.65	334.81	369.62	144.63	349.98	389.27	341.95	383.02	372.29	99.11	346.41	360.70	385.70	363.37	391.05	337.48	407.12	379.44	374.08	387.47	156.24	361.59	390.17			TOTAL GROSS, TONS 8433.47

MONTHLY RECORD — MAY 1918

PRODUCTION ON MISCELLANEOUS ROD SIZES


AVERAGE PER 12 HOURS - FOR MONTH = 211.74 GROSS TONS
NOTE: MILL OPERATED ONLY PART TIME ON ACCOUNT OF STEEL SHORTAGE
GROSS TONS PER 12 HOURS
YIELD
RATE PER 12 HOURS GROSS TONS
PERCENT OF GOOD RODS
DAYS

SIZE OF ROD	5	5	5	5	3	3	3	3	2	2	0	.0 .312	.806 .312 .00	.00 .343	.00 .1	1	1	.393 .406	.406 .393 .363	.363 .430	.462 .468							
HOURS	24	24	24	10	24	24	24	24	24	7	24	24	24	24	12	24	9 4	24	24	12	12	4224	35.20 SINGLE TURNS					
GROSS TONS	384.81	388.38	391.05	155.35	407.12	406.22	466.93	409.80	466.05	133.03	410.68	411.58	392.83	462.48	150.88	454.43	159.81	538.36	474.08	193.74	195.53		TOTAL GROSS TONS 7453.14					



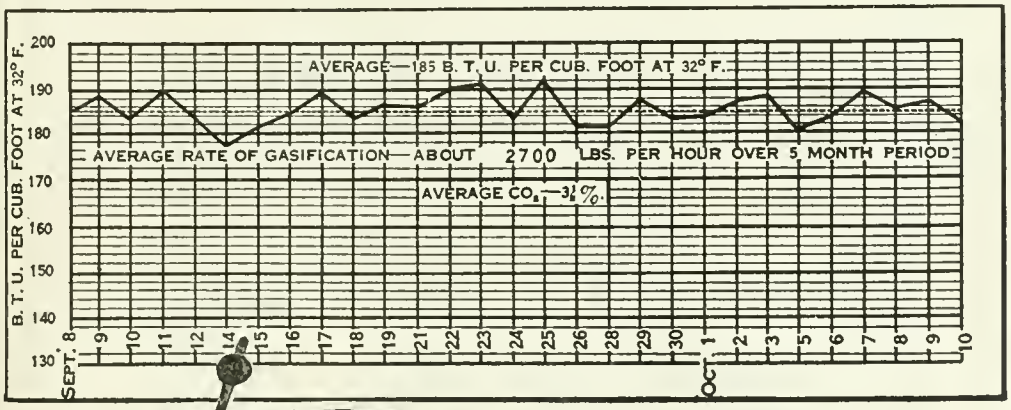
MORGAN CONSTRUCTION CO.
WORCESTER, MASS., U. S. A.

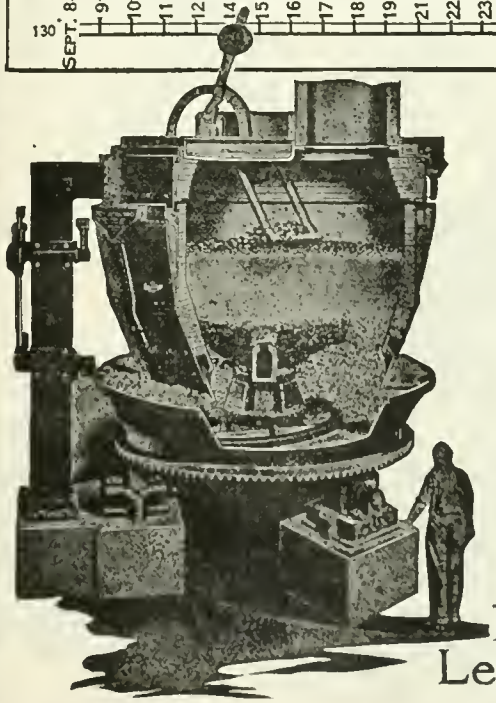
Co-operate:—Refer to The Blast Furnace and Steel Plant

MORGAN
OF WORCESTER
PRODUCER GAS MACHINE

M C Co

Eight-hour Continuous Gas Samples from records of work's chemist at one of the well known Steel Plants in the U.S.A.


B. T. U. PER CUB. FOOT AT 32° F.
200
190
180
170
160
150
140
130
AVERAGE—185 B. T. U. PER CUB. FOOT AT 32° F.
AVERAGE RATE OF GASIFICATION—ABOUT 2700 LBS. PER HOUR OVER 5 MONTH PERIOD
AVERAGE CO₂—3½%
SEPT. 8 9 10 11 12 14 15 16 17 18 19 21 22 23 24 25 26 28 29 30 OCT. 1 2 3 5 6 7 8 9 10



MORGAN PRODUCER GAS MACHINES maintain the quality of gas continuously at a high value - - - the operation is not dependent upon the human element -

Continuous Mechanical Feeding, Levelling and Ash Discharge

MORGAN CONSTRUCTION CO.
WORCESTER, MASS., U.S.A.

MORGAN
ROLLER STRAIGHTENERS
FOR MERCHANT AND STRUCTURAL MILLS

M C Co

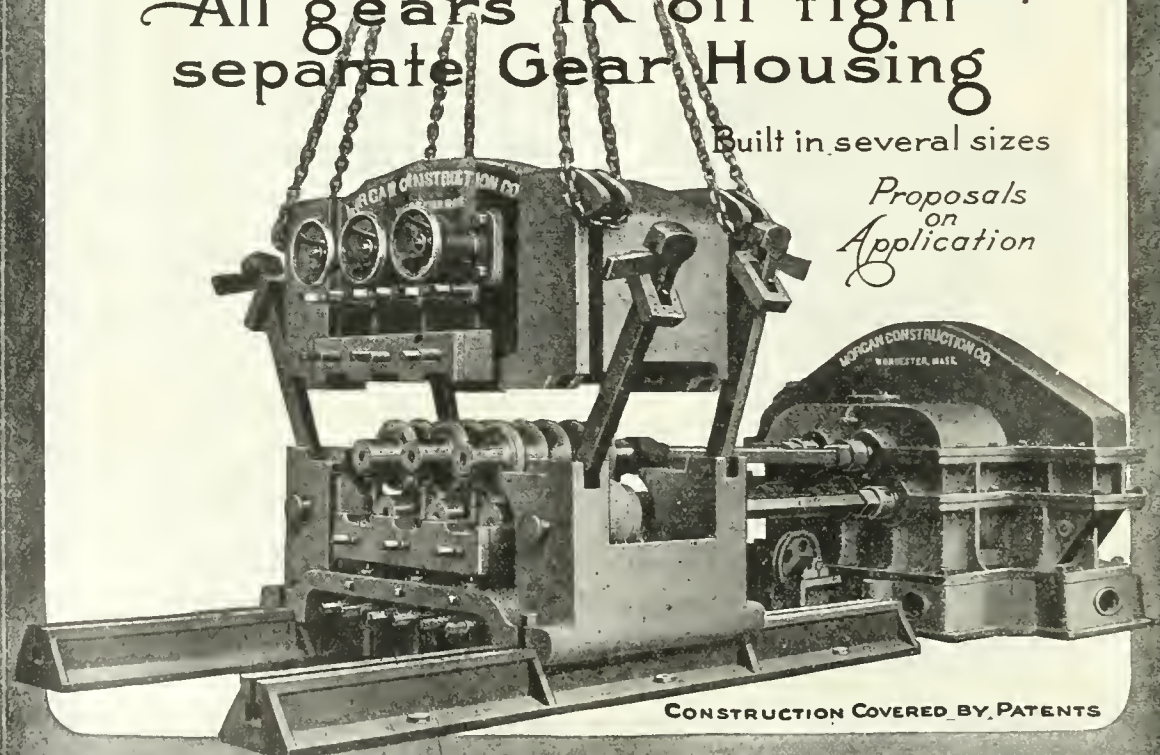
TIME SAVING
All rolls can be changed in
. 20 minutes .

CONVENIENCE
All roll adjustments from
. the front .

CONSTRUCTION
All gears in oil tight
separate Gear Housing

Built in several sizes

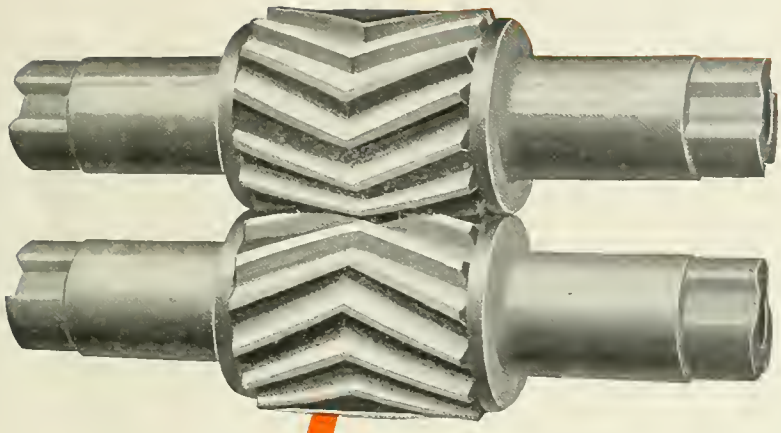
Proposals on Application



CONSTRUCTION COVERED BY PATENTS

MORGAN CONSTRUCTION CO.
WORCESTER MASS. U.S.A.

Co-operate:—Refer to The Blast Furnace and Steel Plant



The dawn of reason found men crude—inefficient. With wisdom came reliance upon men and materials. Today the dependence of the civilized world is more and more upon the HIGHLY EFFICIENT.
—Wilderness Philosophy

Adamite for Production

WHERE increased operating efficiency—greater production with decreased costs—is a vital factor, there is the place for Adamite.

Adamite parts, especially rolls and pinions, are setting production records that are impossible with iron or steel. Adamite is performing so well, in so many thousands of the best mills in the country that today it is the recognized standard upon which all roll and pinion service is based. The eternal question has become

Will it Perform as well as Adamite?

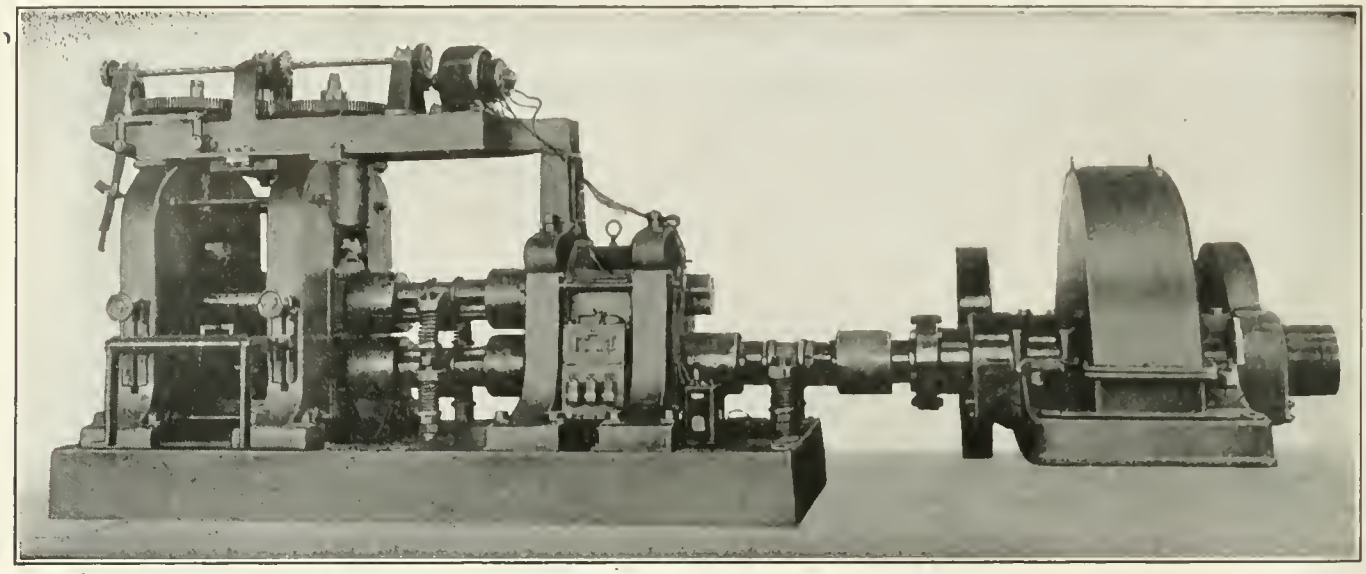
Is YOUR *mill equipped with Adamite? If not, you can put it on a higher production basis and cut your operating costs materially by giving Adamite an opportunity to show what it can do.*

PITTSBURGH IRON & STEEL FOUNDRIES CO.

Executive Offices:—Pittsburgh **Foundries:—Midland, Pa.**

United Engineering & Foundry Co., Pittsburgh, Sole Licensees

Co-operate:—Refer to The Blast Furnace and Steel Plant



Motor Driven Strip Finishing Mill with Motor Screwdown and Cut Herringbone Gear Drive.

CHILLED, SAND AND STEEL ROLLS

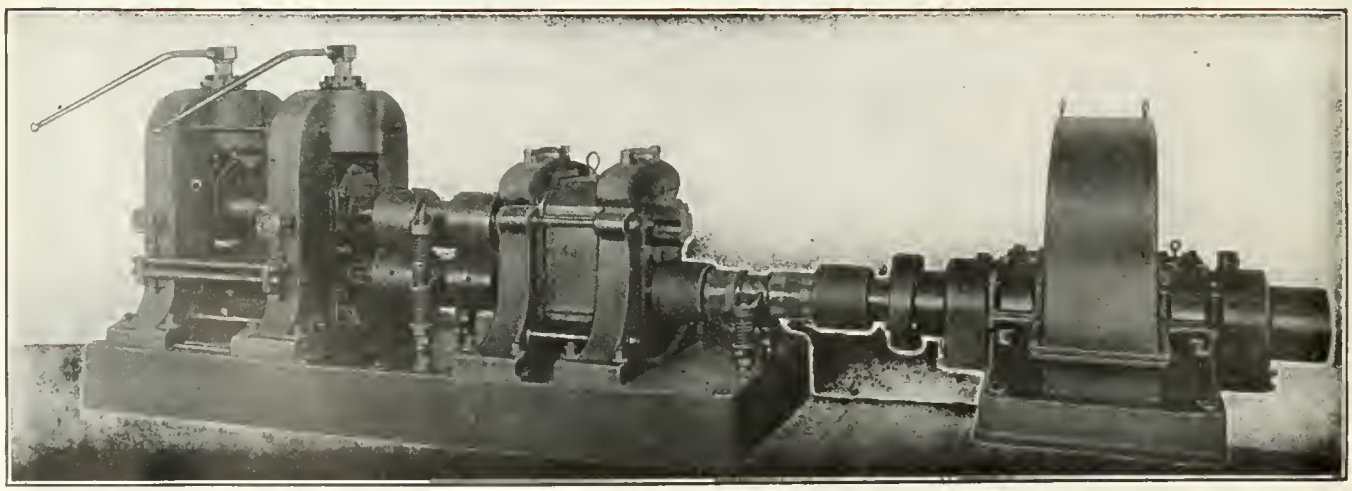
Rolling Mill Machinery—All Types of Shears—Roll Lathes

LEWIS FOUNDRY & MACHINE COMPANY

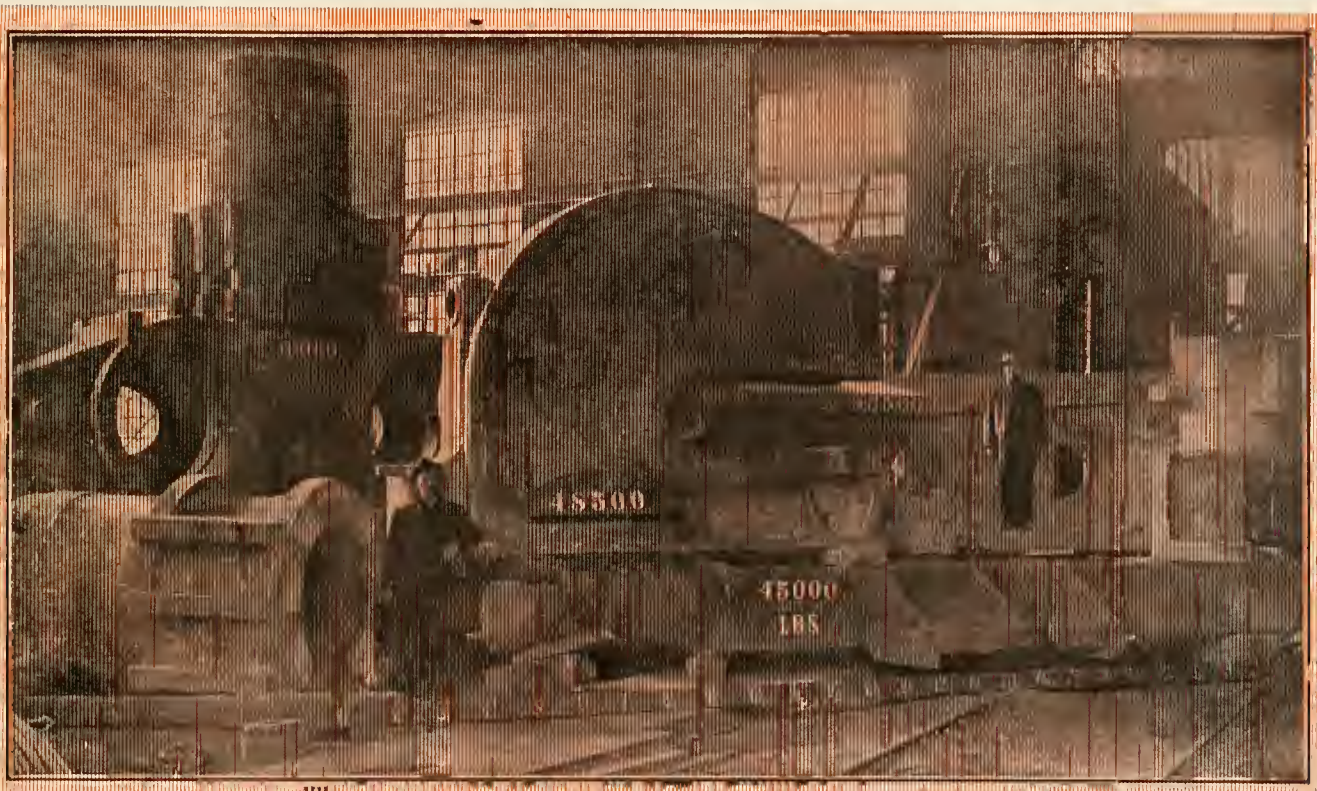
PITTSBURGH, PA.

Works:
Groveton, Pa., on the
P. & L. E.

Office:
503 Farmers Bank Bldg.,
Pittsburgh, Pa.



Motor Driven Strip Roughing Mill with Cut Herringbone Gear Drive.



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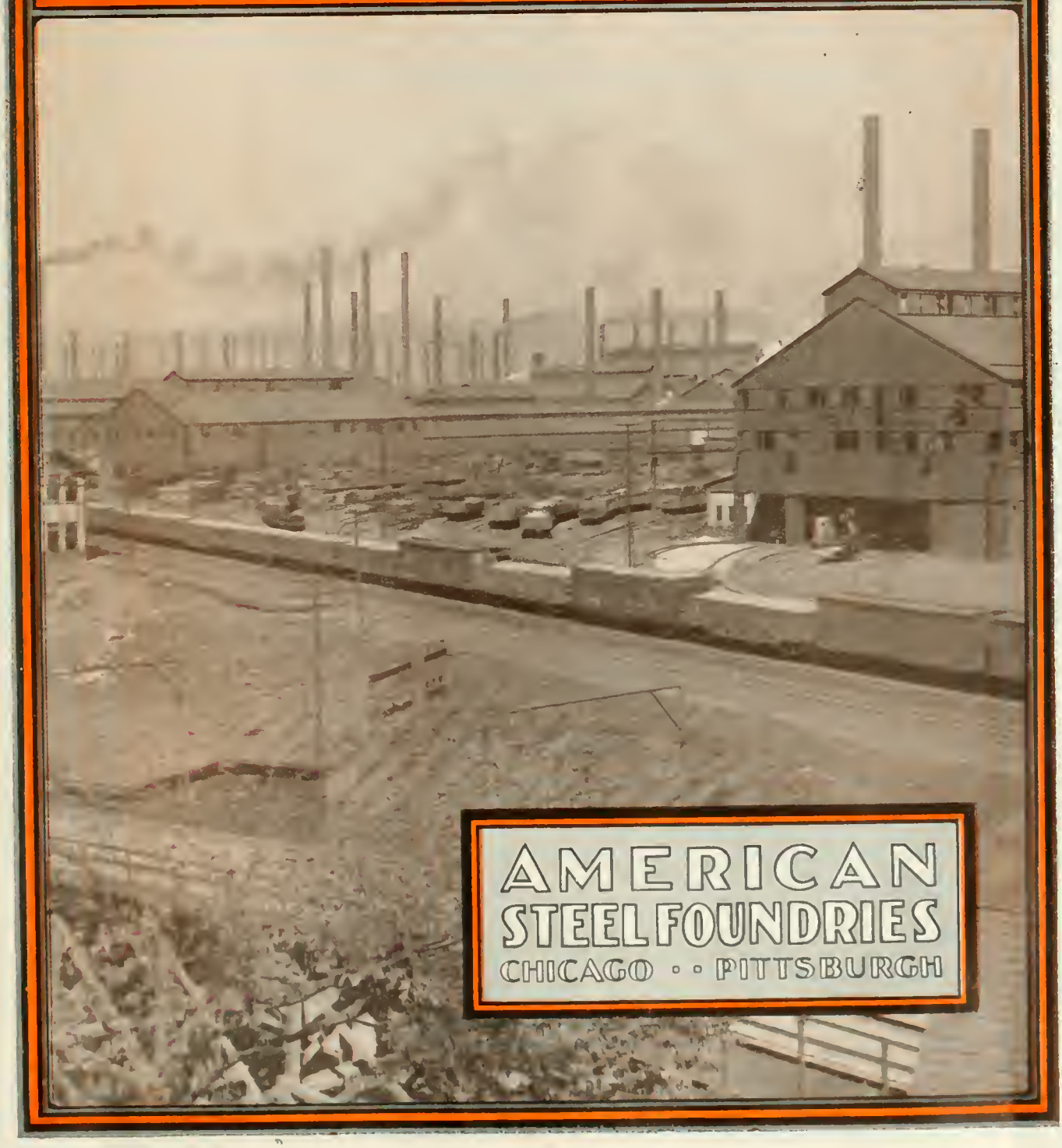

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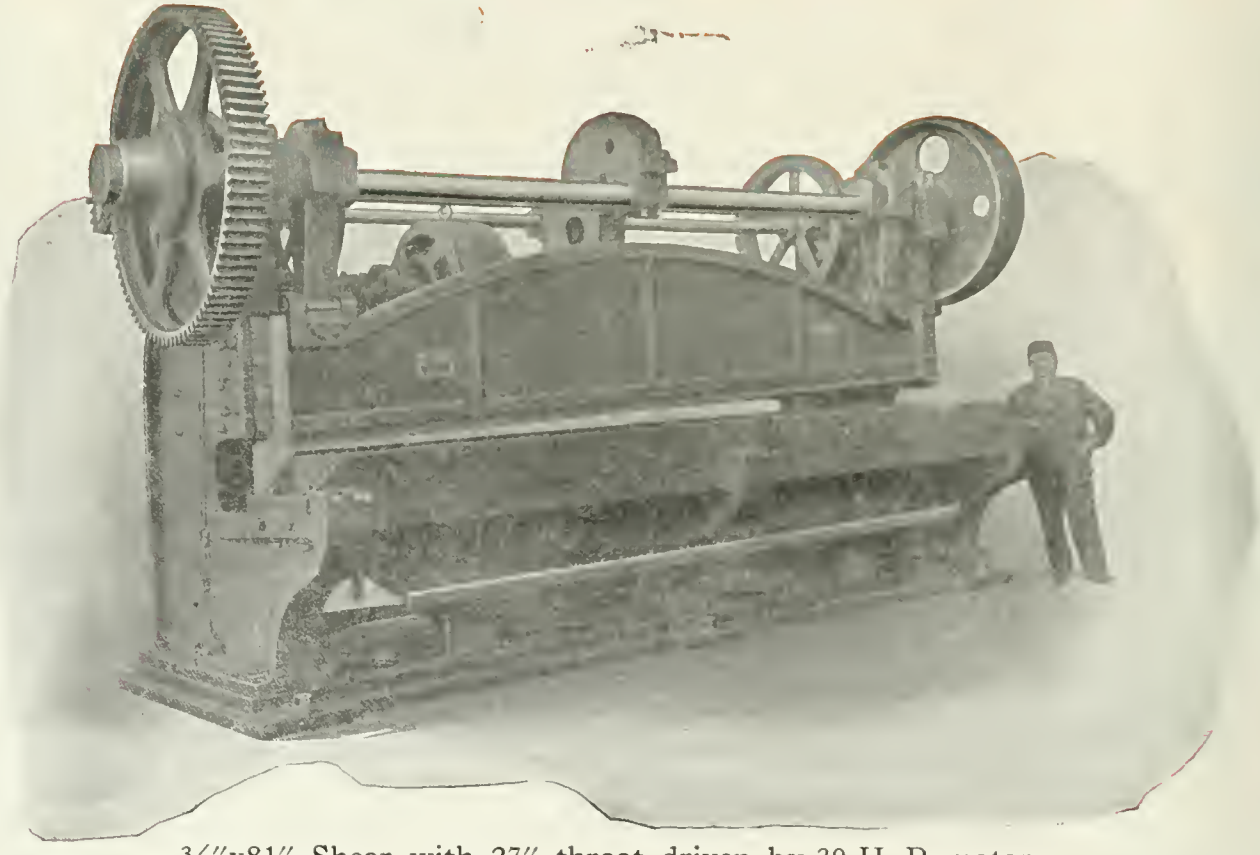
PLATE SHEAR



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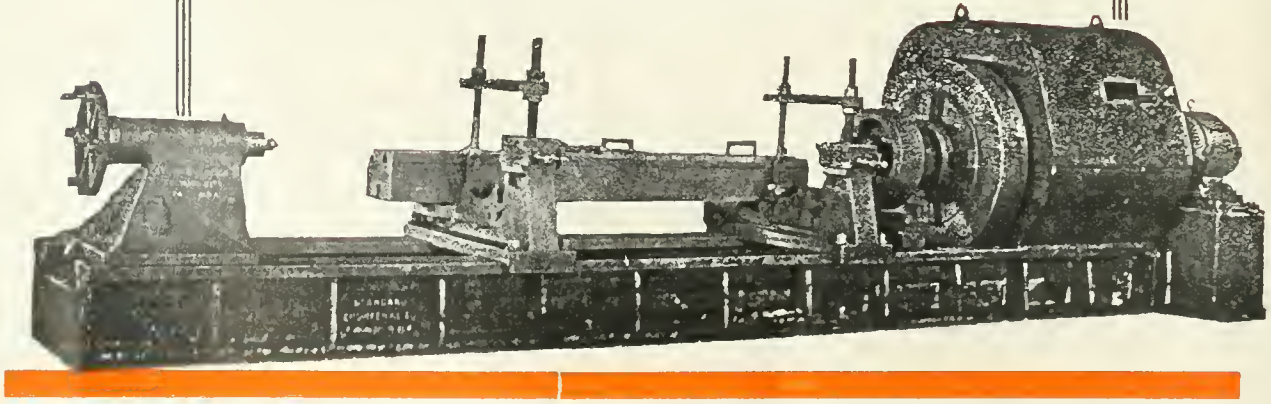

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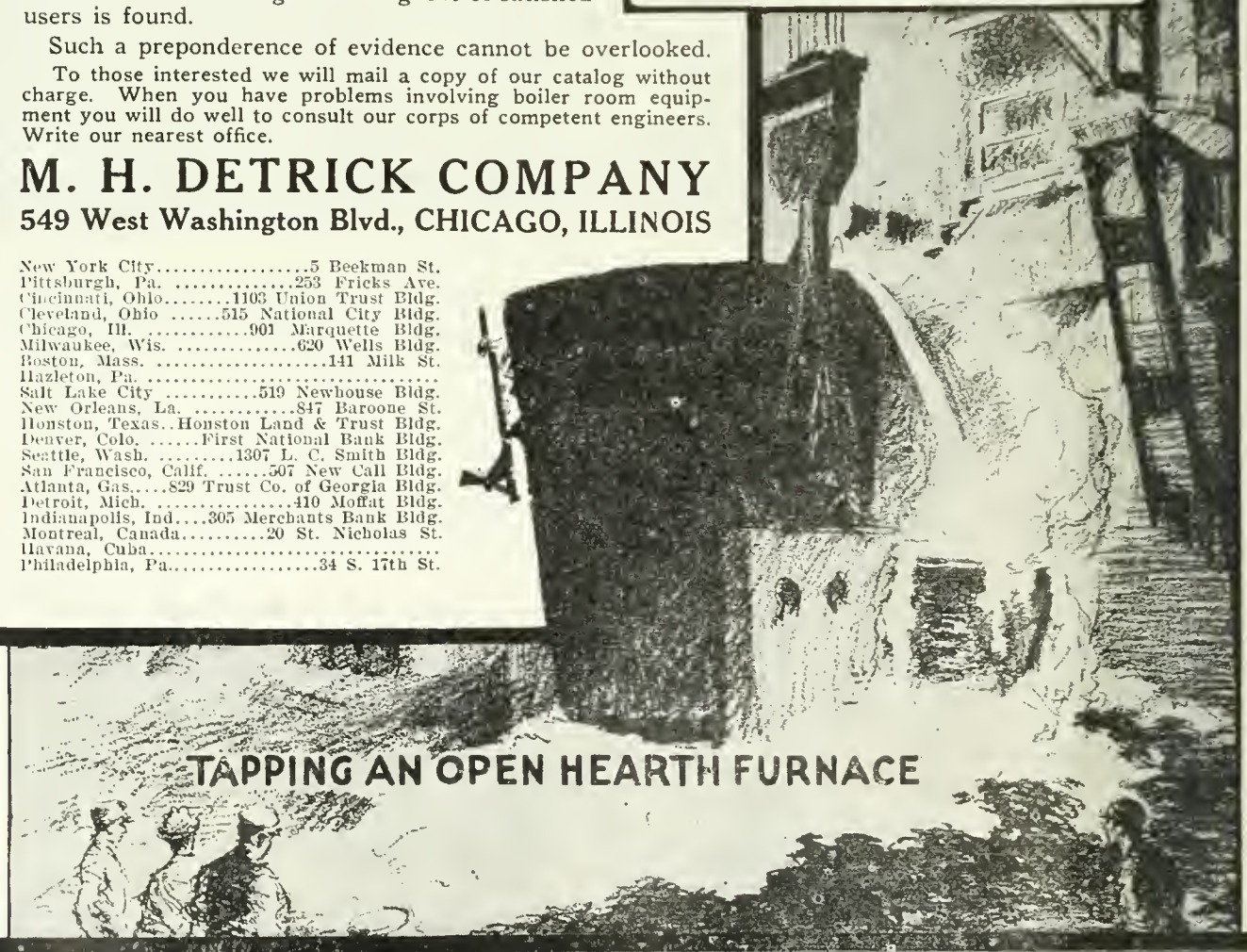

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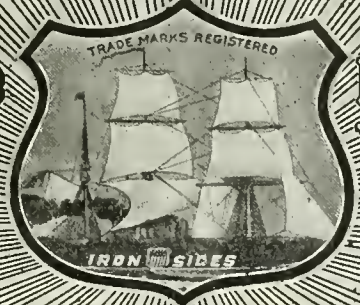

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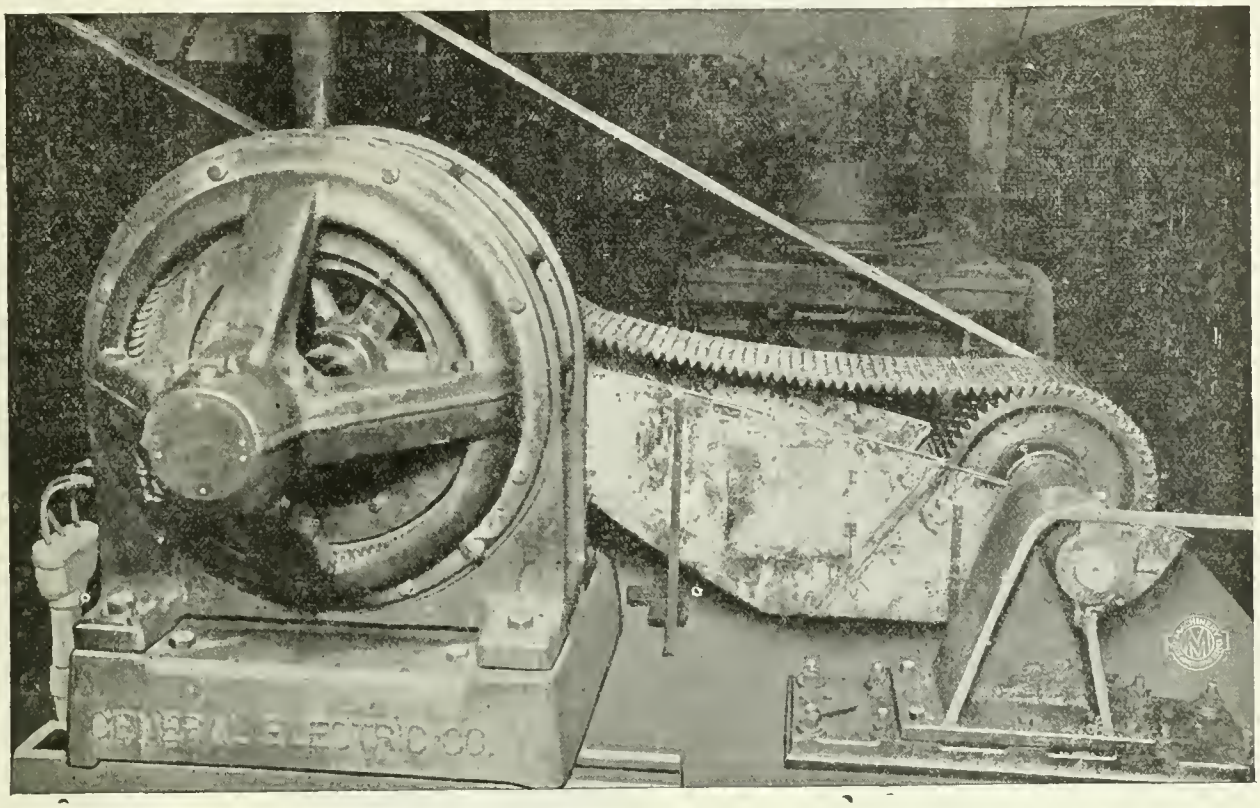

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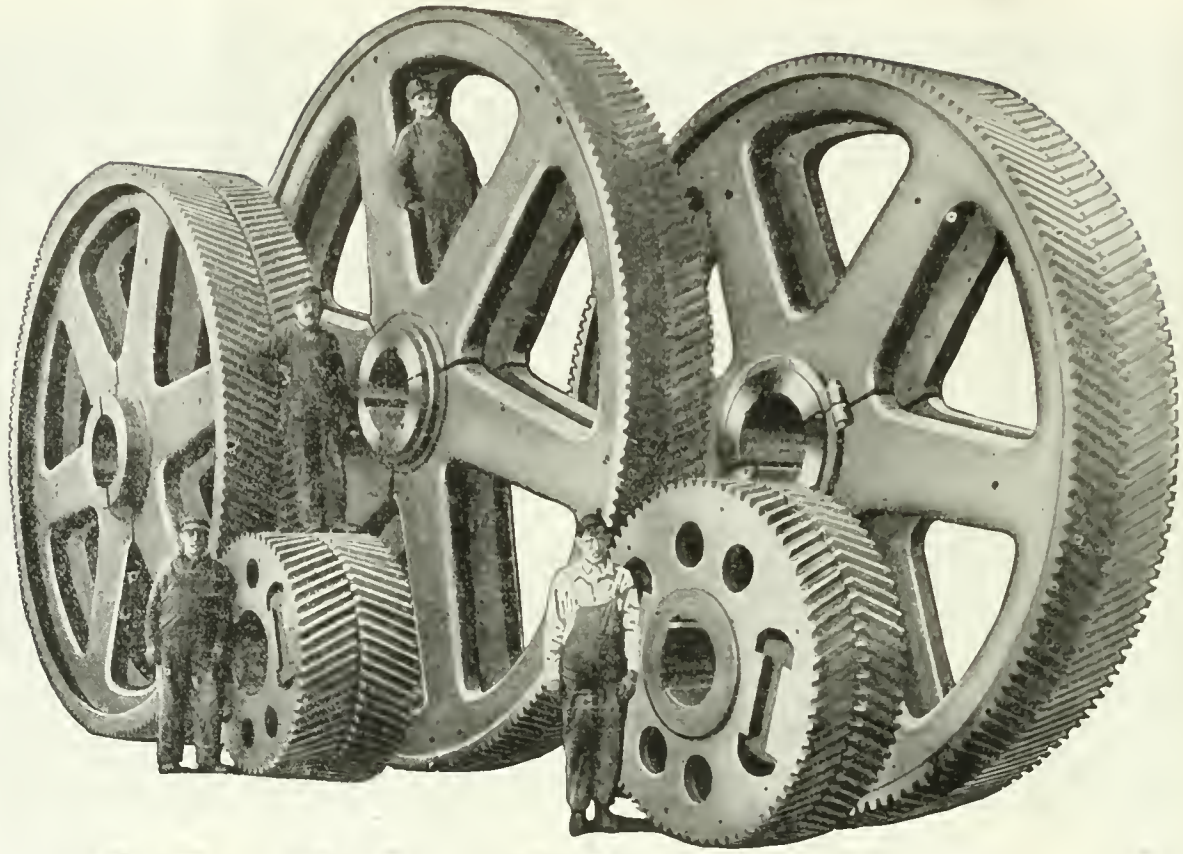

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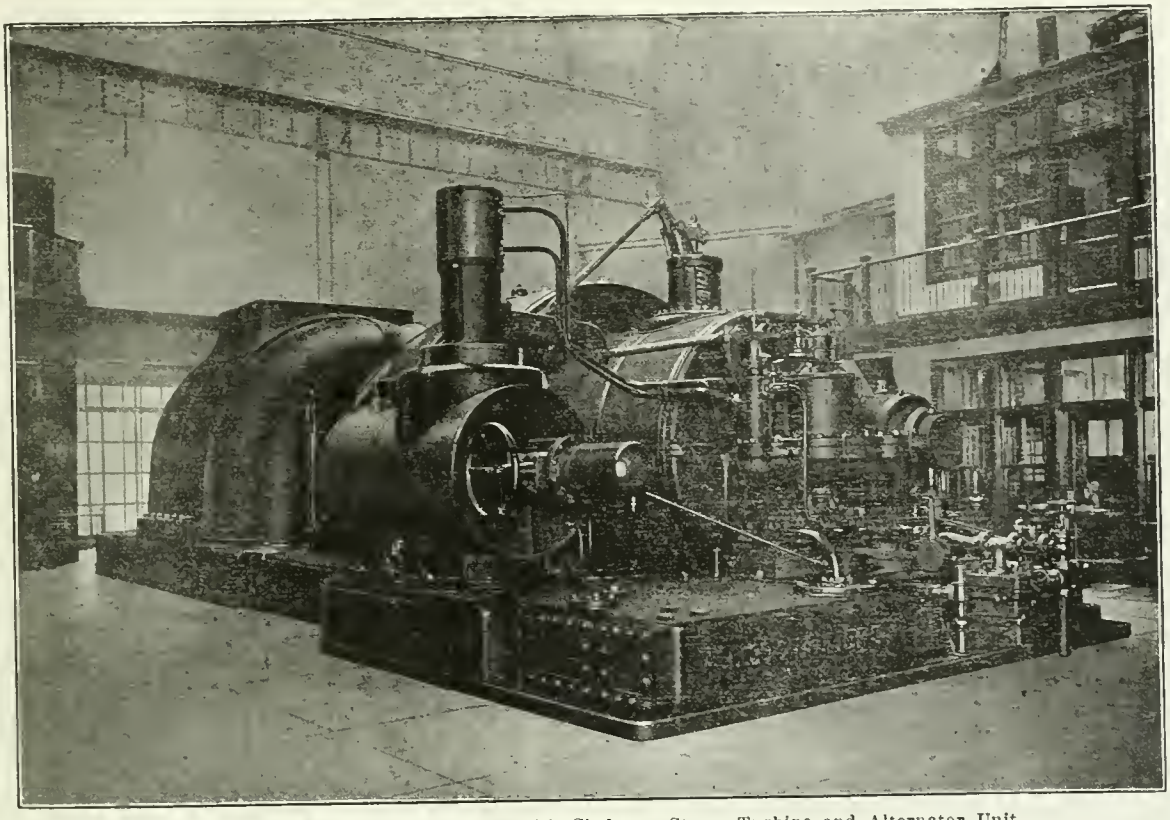

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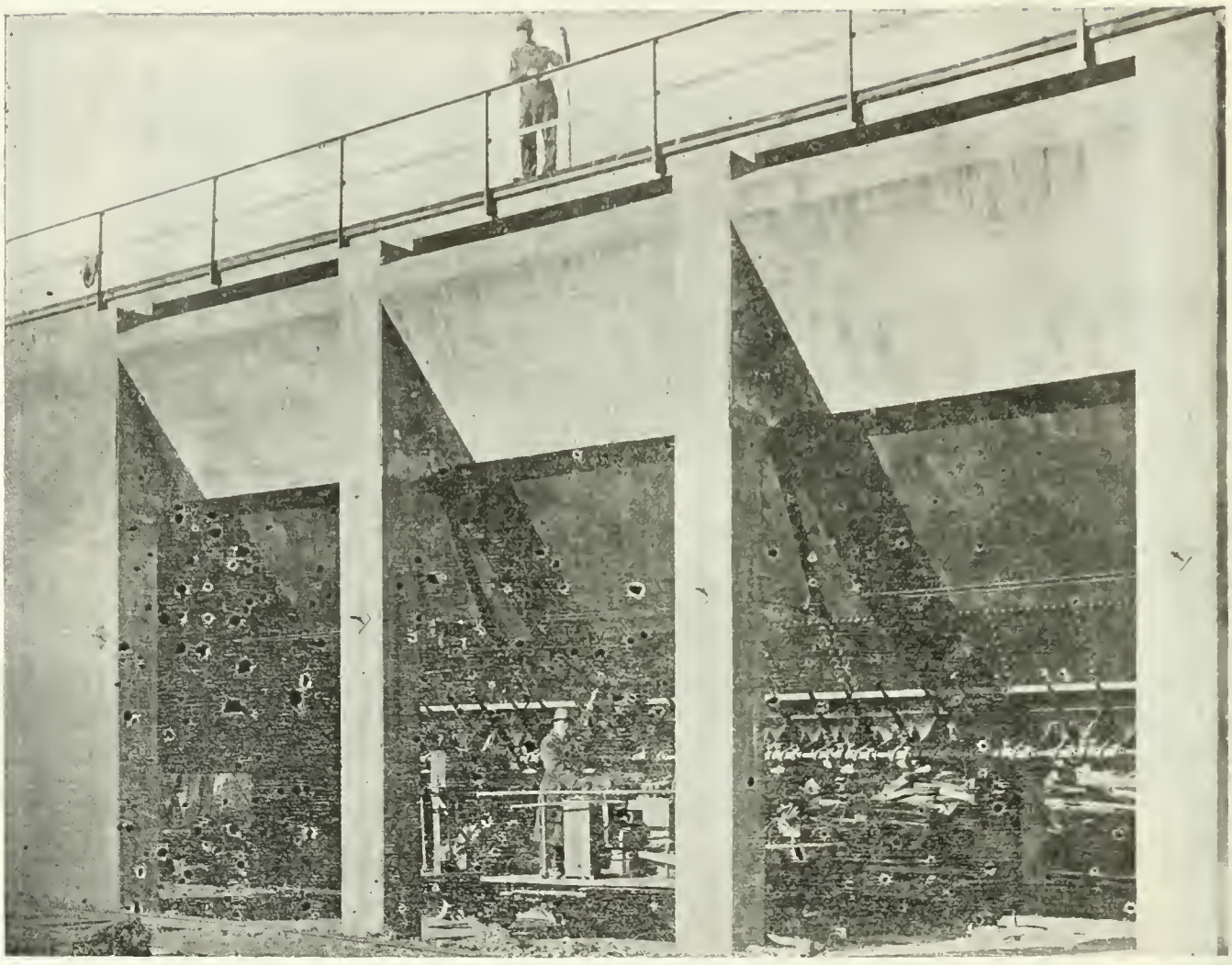

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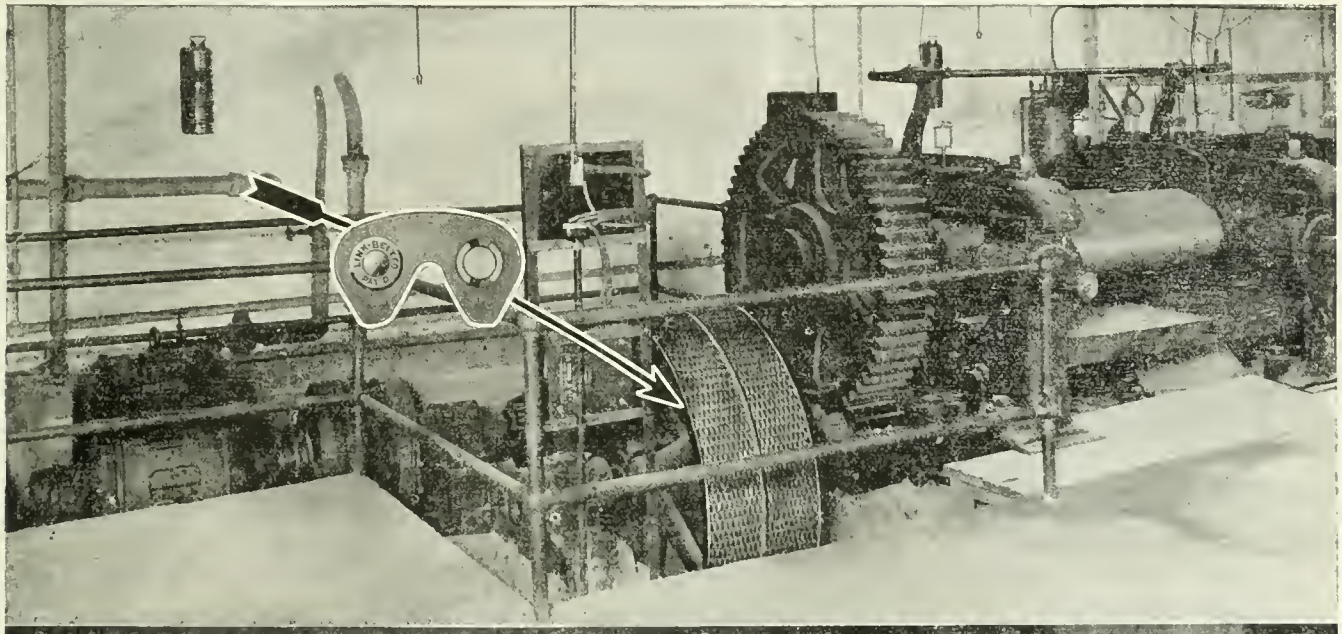

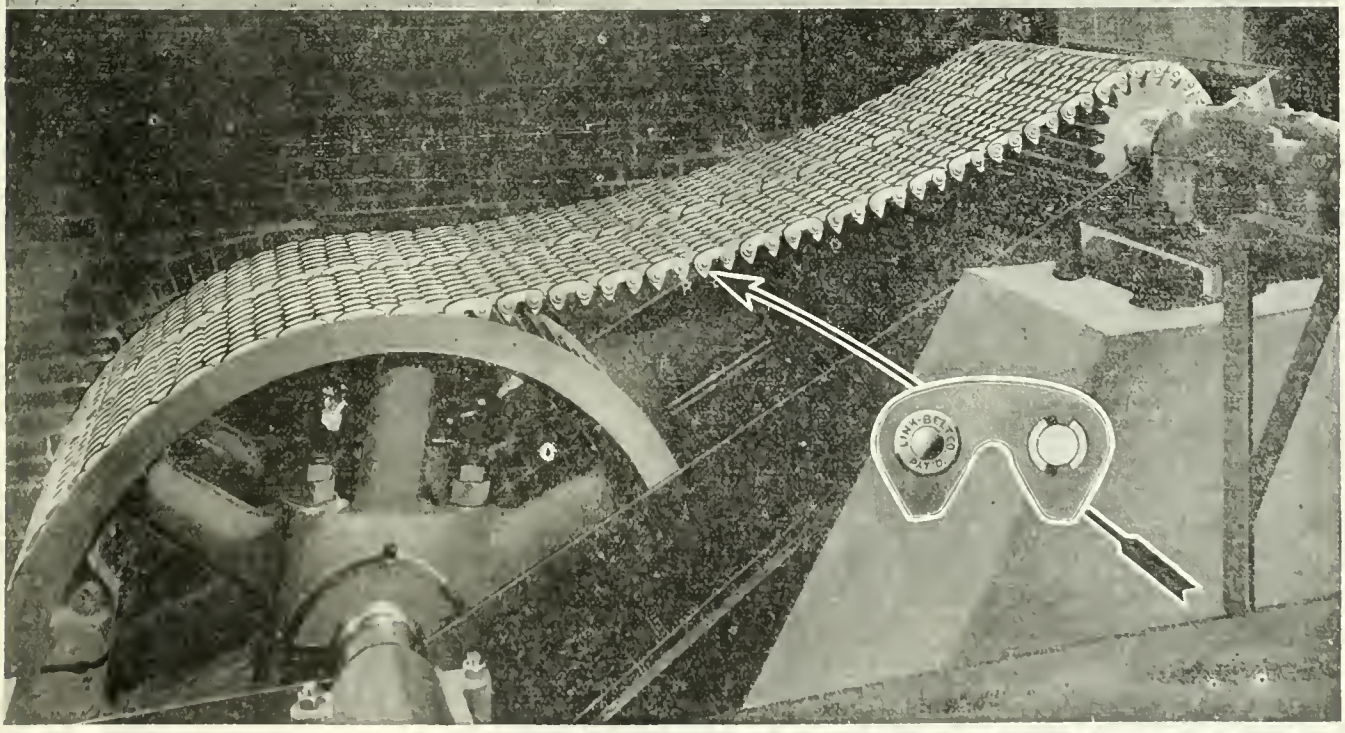

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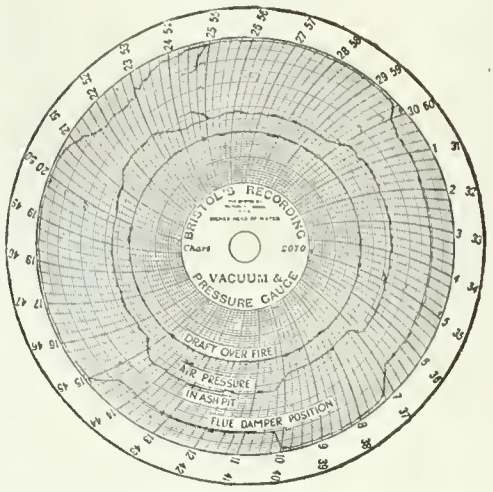

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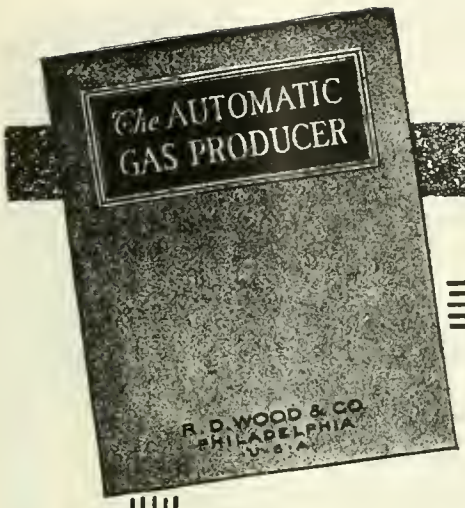

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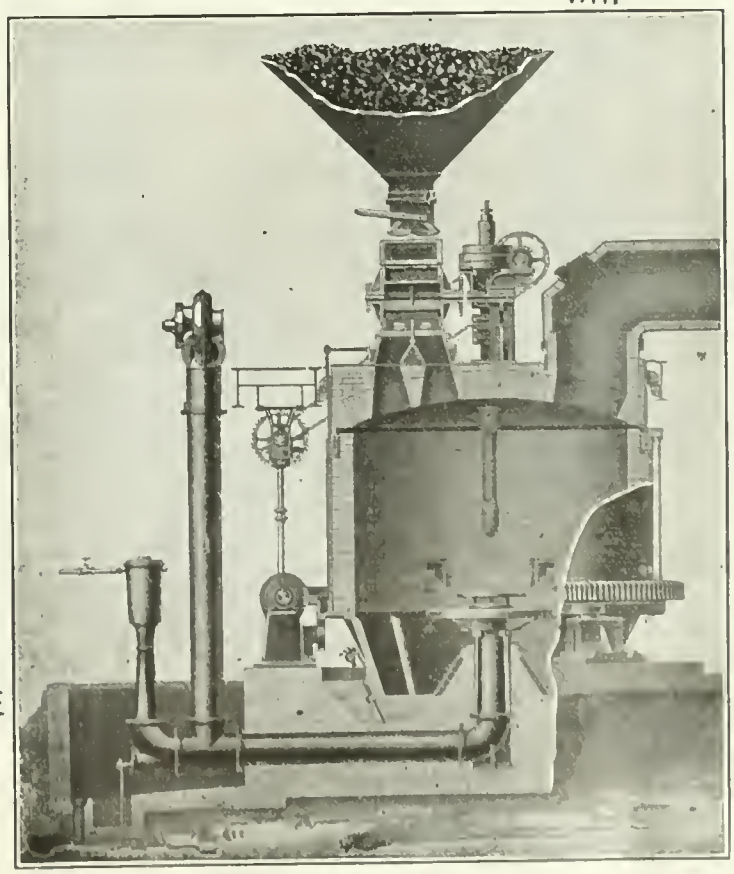

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Of the Royal Testing Bureau at Gross-Lichterfelde, Germany
Authorized Translation from the German
By William T. Hall and Robert S. Williams
Assistant Professors of Analytical Chemistry, Massachusetts Institute of Technology

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A complete treatise on the sampling and chemical analysis of iron and steel, translated from the widely known German text, but amplified so as to cover the best American practice.

CONTENTS

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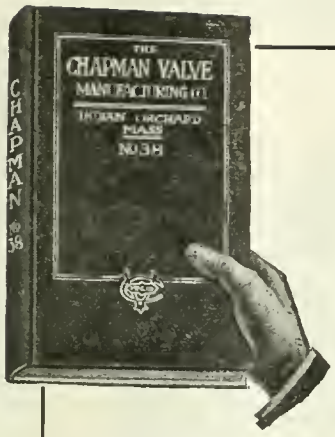

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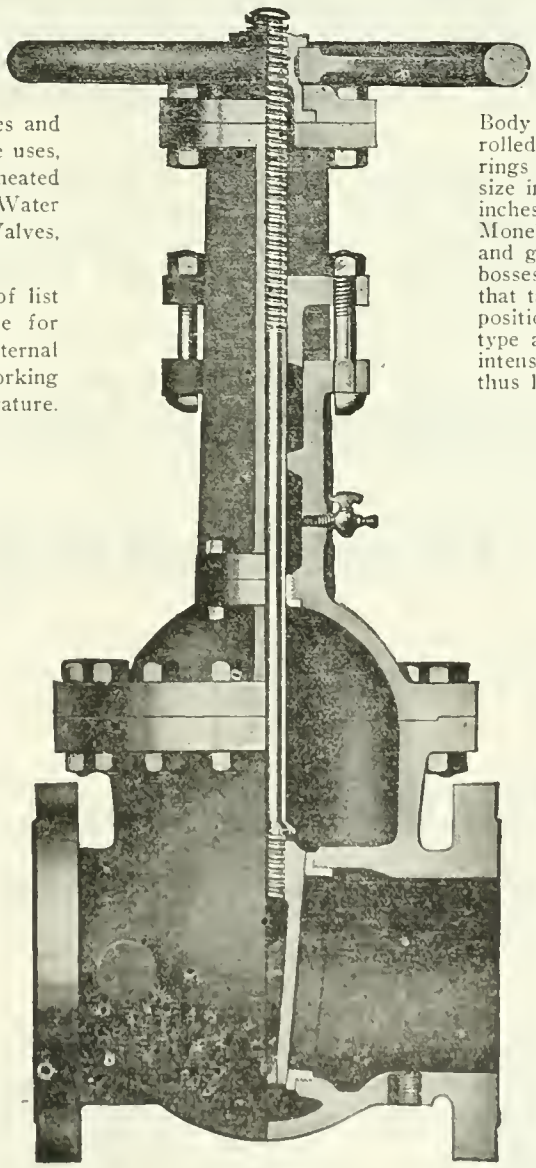

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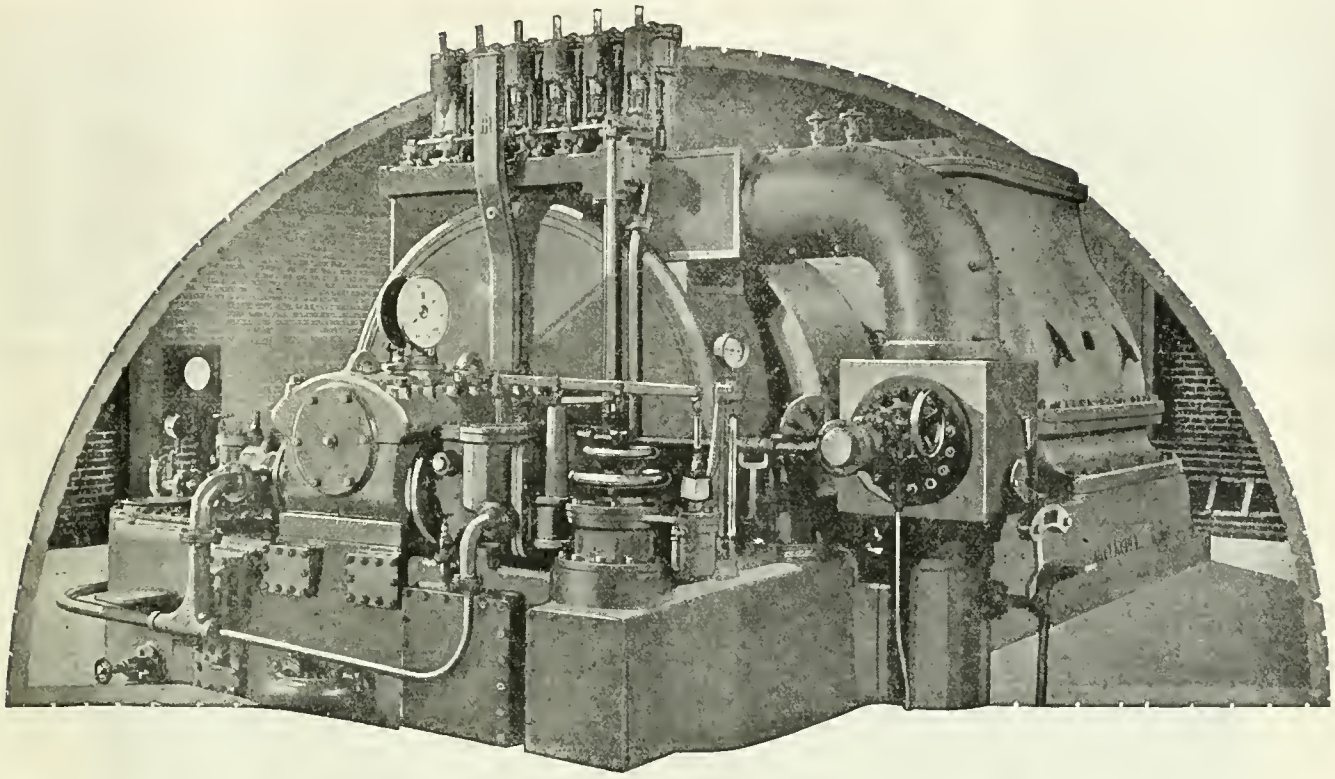

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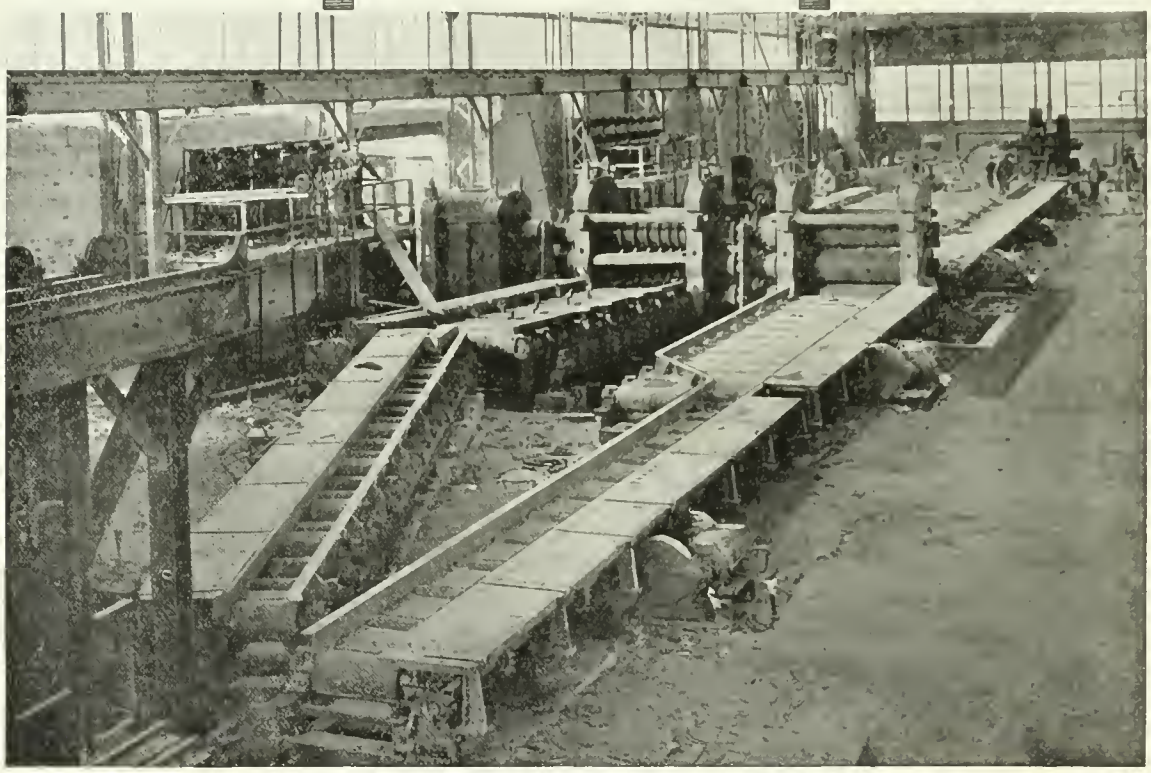

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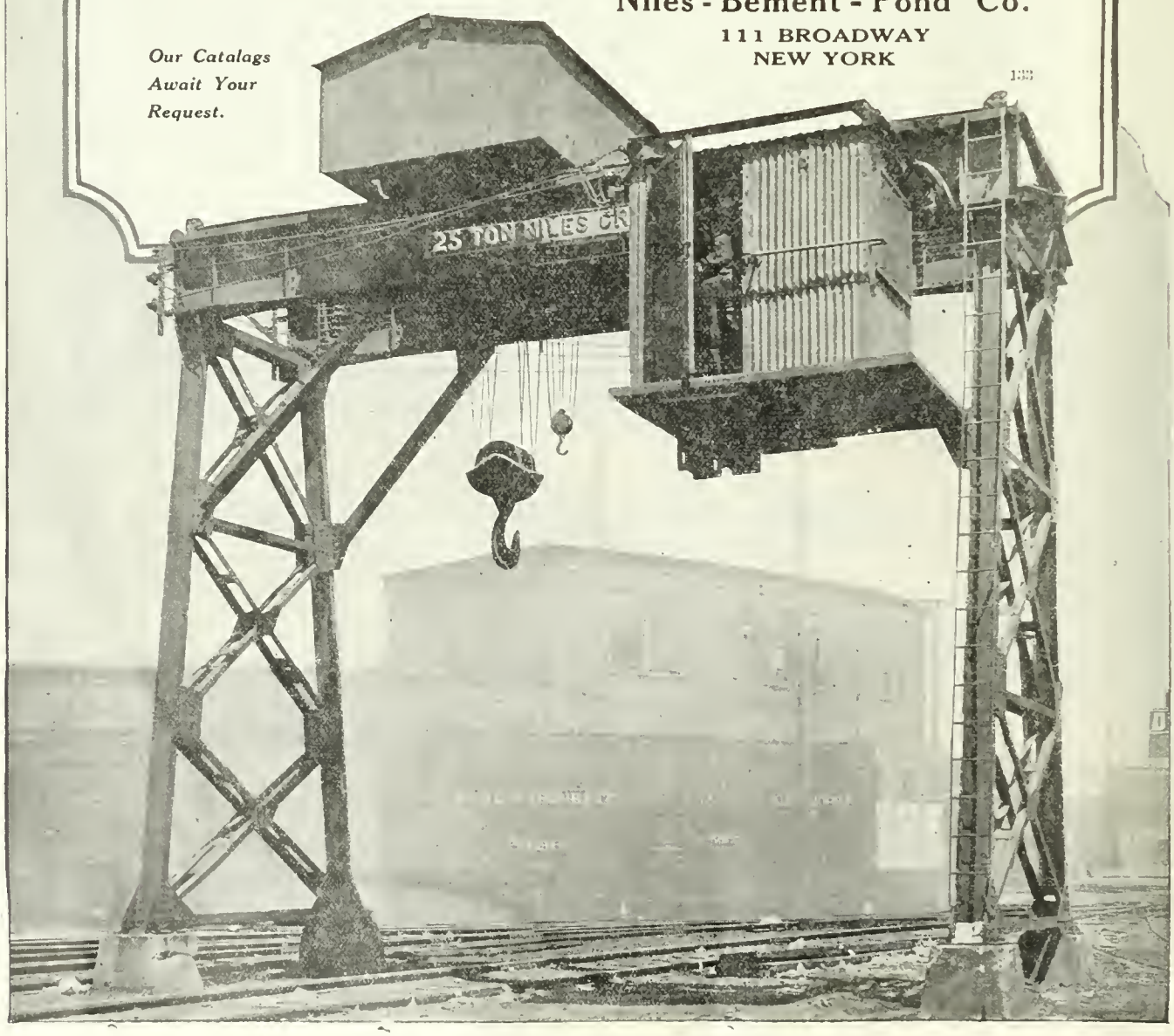

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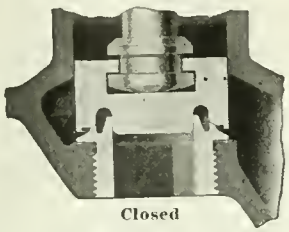
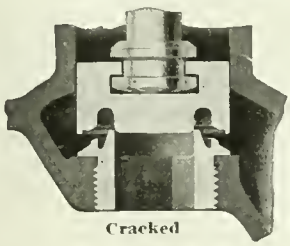
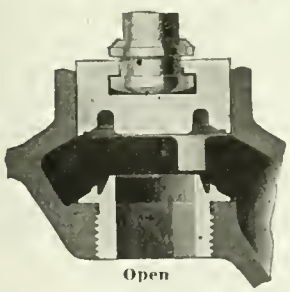


Closed



Cracked



Open

Unless positive means of prevention is provided, the cutting from wire drawing between the seat and disc of a valve will rapidly destroy the seating surfaces. This is especially true under high pressures and temperatures, where very small leaks will rapidly grow on account of the terrific erosive action making the life of the valve very short, increasing the upkeep cost, due to frequent repairs and renewals.

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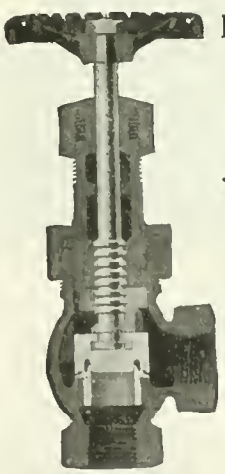

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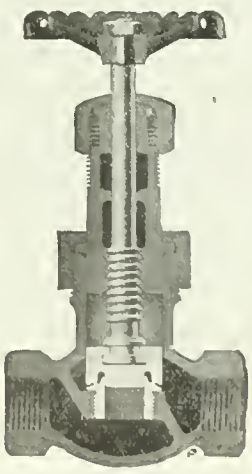

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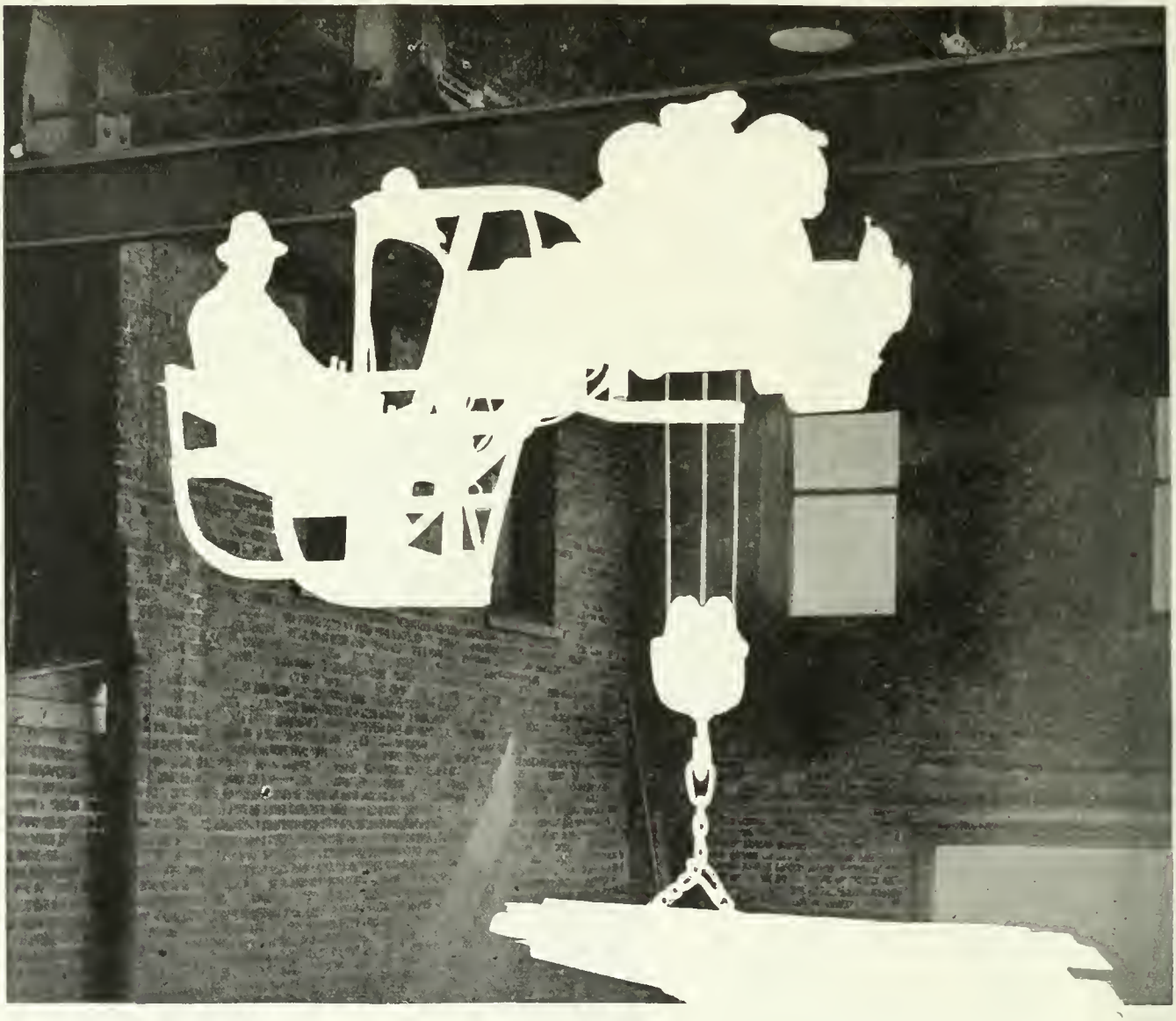

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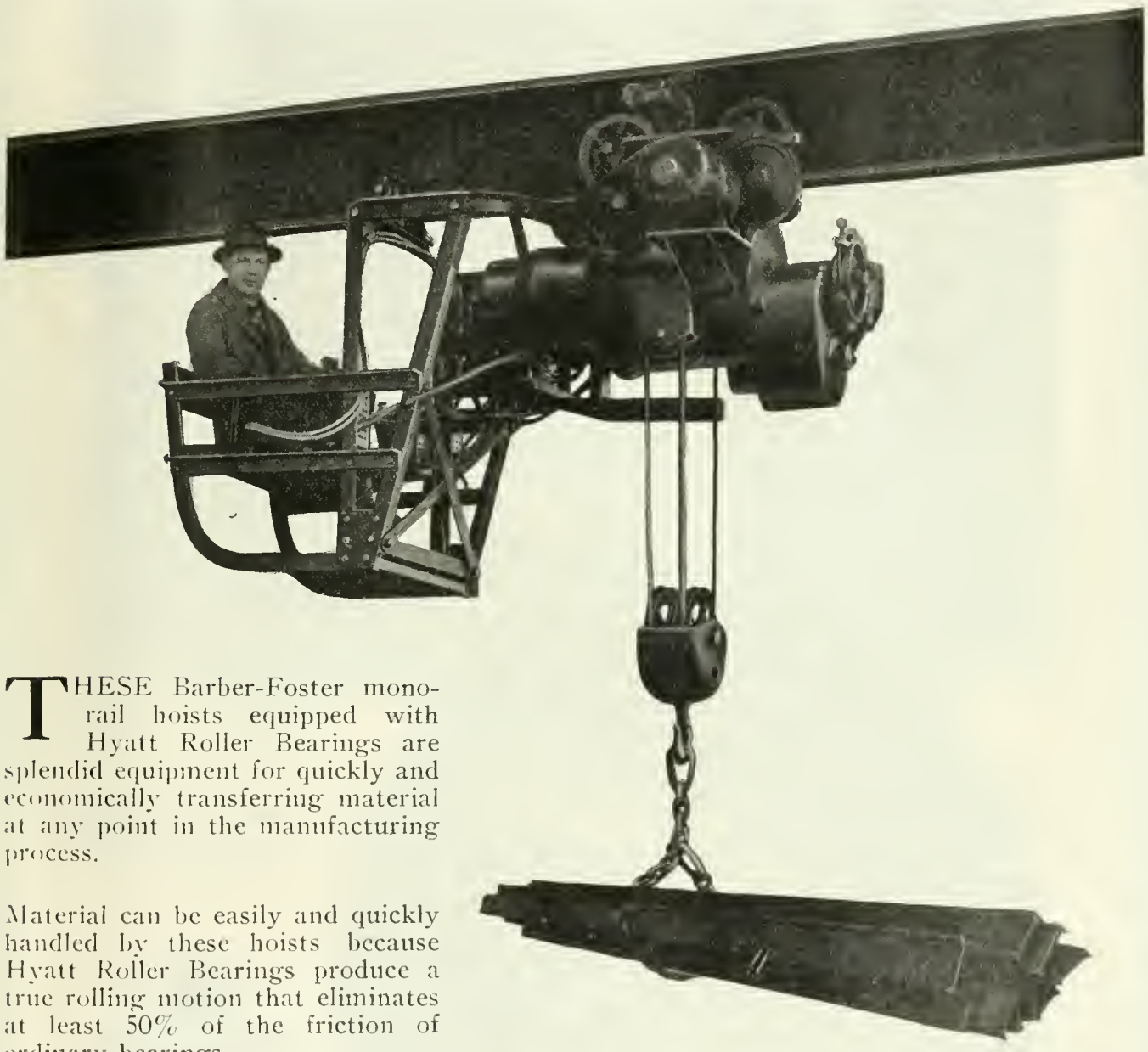

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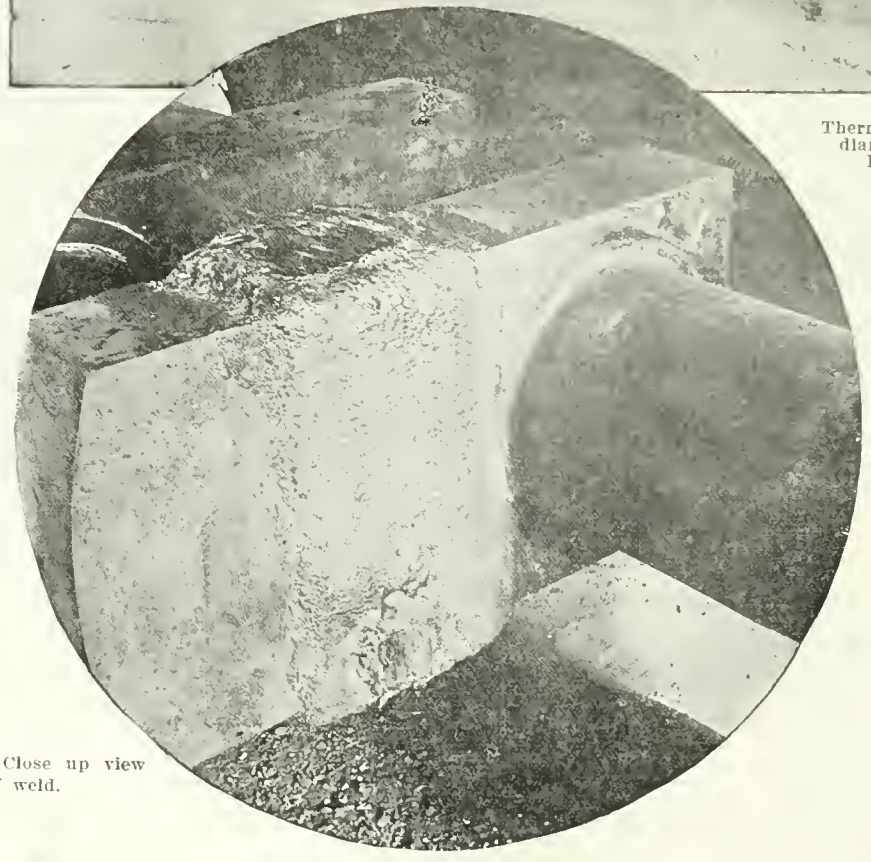

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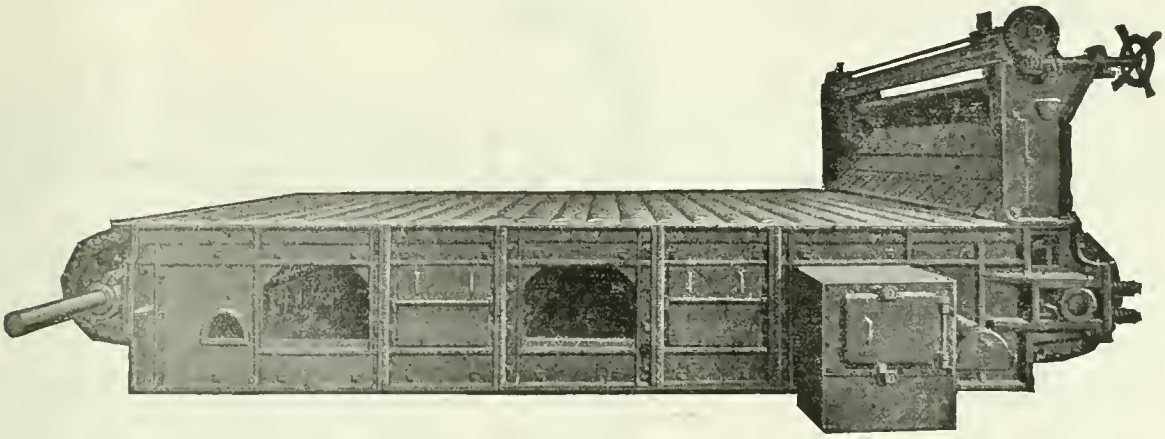

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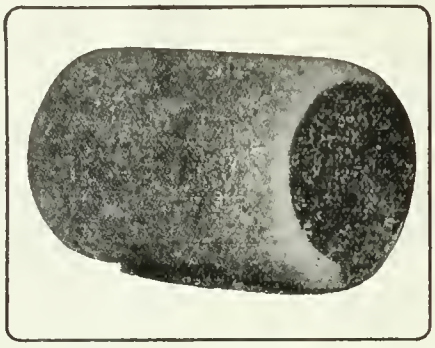

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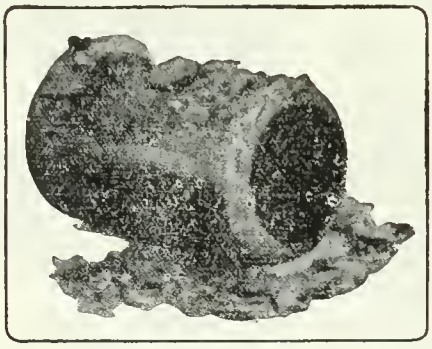

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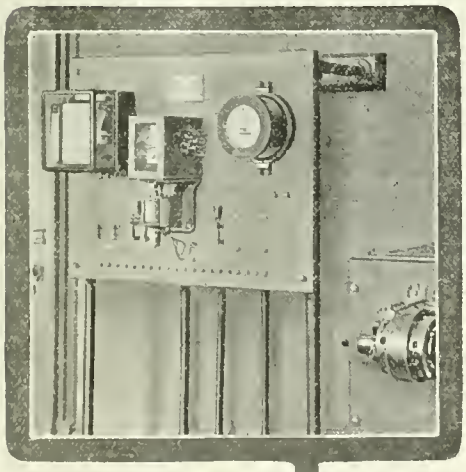

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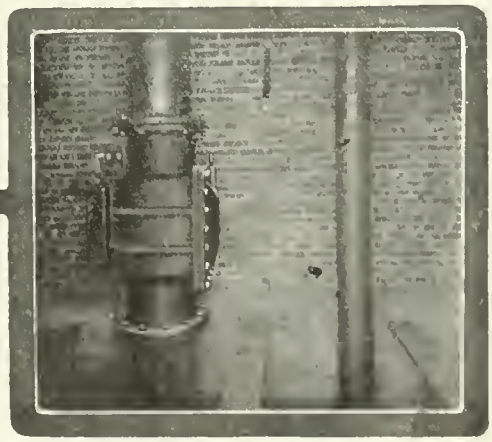

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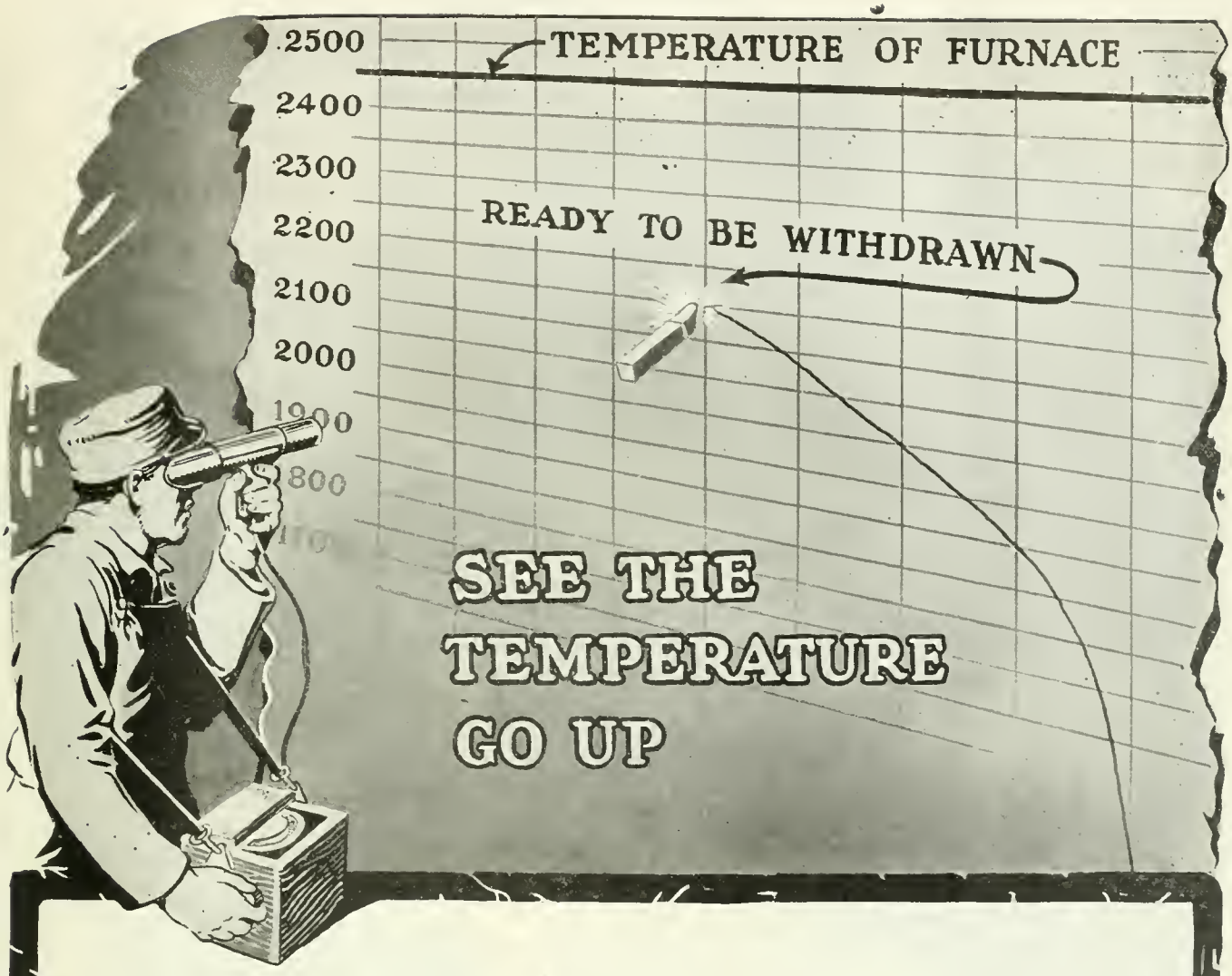

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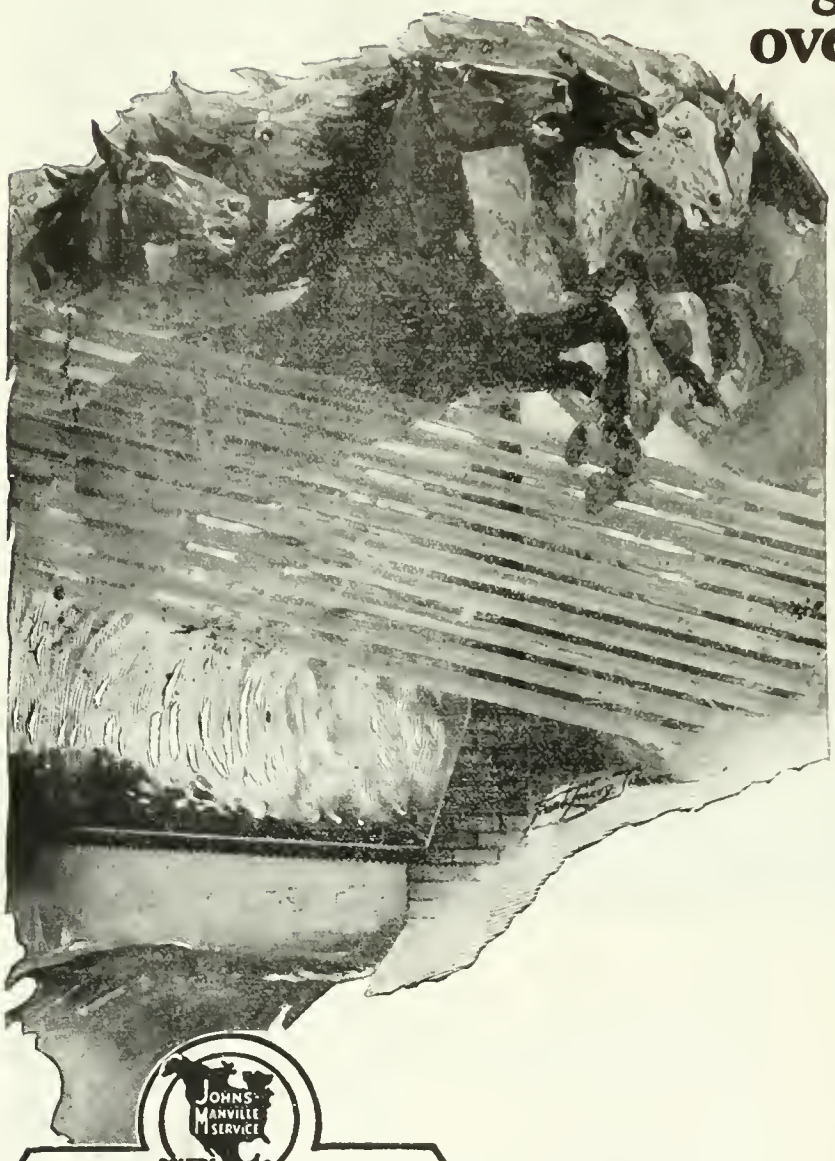
59

Putting horse-power over the jumps



THE blasting heat that most of us have felt as a boiler fire door is opened is cool compared to the white hot gases further in, that rise from the incandescent fire bed to be sucked back through the boiler and to the stack.

Their rush is swift, but before they can reach the stack, they have been forced to take the longest and most devious path through great racks of water-filled tubes, so that the water in the tubes will have every possible opportunity to absorb the heat from the gases.

To force them to take this longest path through the boiler, hurdles have been devised by engineers, over which this plunging flood of heat, energy, horse-power, must go, over and under, and up and down.

These hurdles, or baffle walls, as they are called, once presented many difficulties from a structural standpoint. They obviously must withstand great heat. They must be flame-tight, even though necessarily pierced and honeycombed by hundreds of tubes that change size as they heat or cool.

Johns-Manville has introduced a new departure in baffle construction, that of pouring the wall around the tubes just as concrete is poured.

Such baffle walls are really leak-proof and resistent to high furnace temperatures, and unaffected by contraction and expansion of the tubes passing through them. They make new fuel economies possible in steam boiler operation.

This is but one of the many departments of Johns-Manville Engineering in the great cause of power saving. In addition to Baffle Walls, a complete line of *High Temperature Cements* has been developed to protect boiler fireboxes, retorts, cupolas, and dryers from destruction by high heats.

For the prevention of air leakage or infiltration there are other materials to be applied to the outside of boiler settings—all a most vital work in the conservation of fuel.

H. W. JOHNS-MANVILLE CO.
New York City
10 Factories—Branches in 63 Large Cities
For Canada
Canadian Johns-Manville Co., Ltd., Toronto

JOHNS-MANVILLE SERVICE
COVERS THE CONTINENT

Through—

Asbestos
and its allied products

INSULATION
that keeps the heat where it belongs
CEMENTS
that make boiler walls leak-proof
ROOFINGS
that cut down fire risks
PACKINGS
that save power waste
LININGS
that make brakes safe
FIRE PREVENTION PRODUCTS

Here are a few Johns-Manville products:

Monolithic Baffle Walls
Refractory Cements
Asbestos Insulating Cements
Asbesto-Sponge Felted Pipe Insulation
Asbesto-Sponge Felted Sheet and Block Insulation
85% Magnesia Pipe Insulation
85% Magnesia Block Insulation
Built-Up Brine and Ammonia Insulation
Cold Water Pipe Insulation
Vitrobestos Stack and Breeching Lining
Steam Traps

JOHNS-MANVILLE
Serves in Conservation

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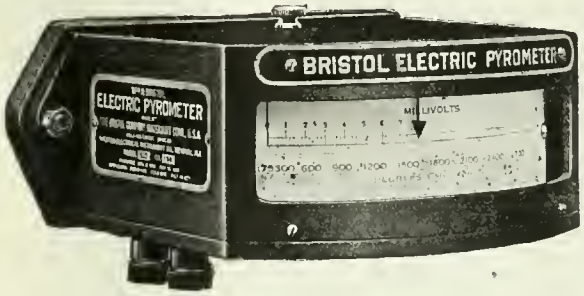
TRADE MARK
BRISTOL'S
REG. U. S. PAT. OFFICE.

QUALITY and SERVICE



Indicating Pyrometer Model 319.
High Resistance

The Original High Standard of Bristol's Instruments has at all times been maintained—there has been no relaxation of effort, no substitution of inferior materials or workmanship. Thus to preserve the standard has often been extremely difficult and sometimes at the sacrifice of better deliveries. However, living up to the standard has well repaid, and appreciative users of Bristol's Instruments have been kind enough to compliment on this particular feature.

Recording Pyrometer Model 437 for temperatures up to 3,000° F.

Developments and improvements have also been taking place which include some very important inventions, so that now the Bristol's Line of Instruments are more extensive and up-to-the-minute in details than ever before.

In addition to the mechanical progress has come a very decided expansion in the organization. This permits of more prompt and painstaking service and the ability to more closely study your application requirements for Bristol's Instruments for Recording, Indicating and Controlling.

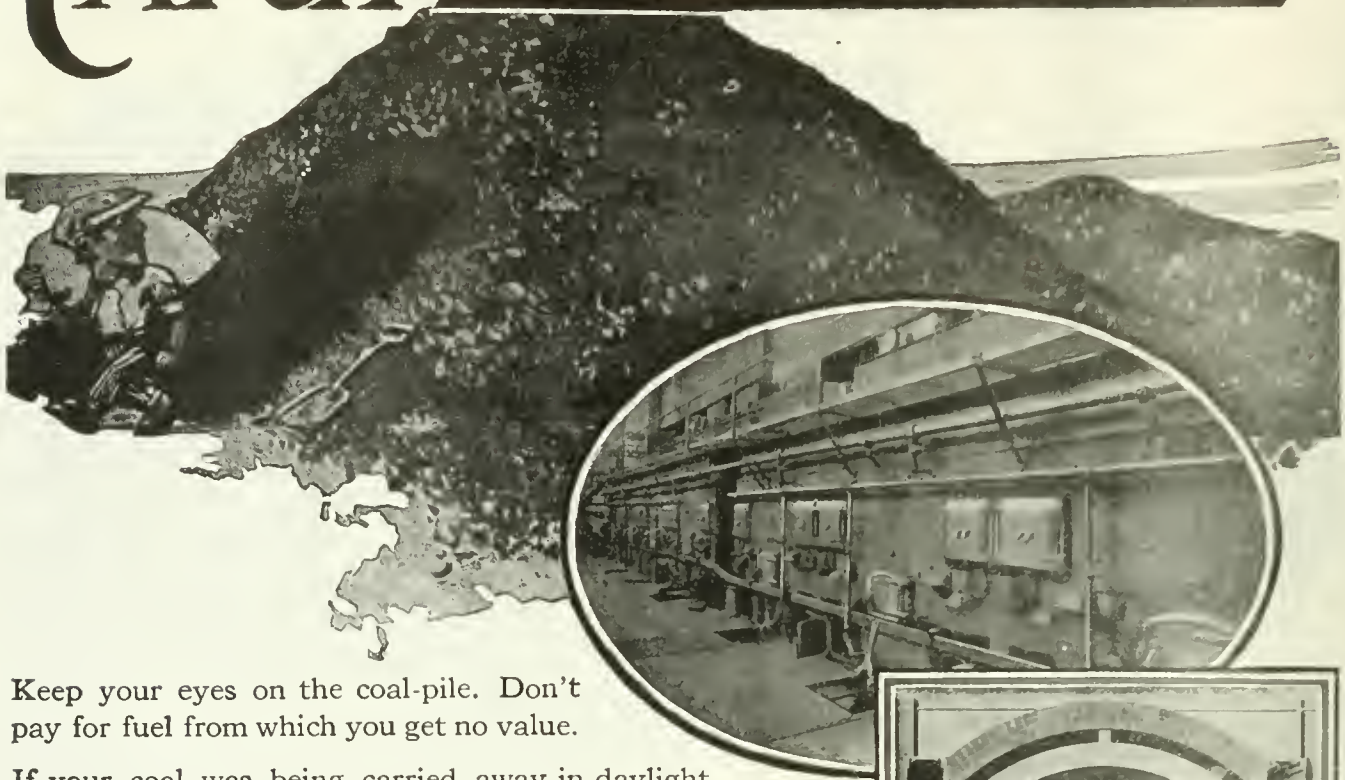
Let our Sales Engineers serve you. Bulletin AD-274 tells something about Bristol's Pyrometers. Where shall we send your copy?

The Bristol Company, Waterbury, Conn.

Branch offices:

Boston **New York** **Pittsburgh** **Chicago** **San Francisco**

CATCH THE COAL PILE THIEF



Keep your eyes on the coal-pile. Don't pay for fuel from which you get no value.

If your coal was being carried away in daylight, you would immediately stop the loss. Possibly you may have overlooked the biggest thief of all. *Boilers inefficiently fired* will steal more coal every day and lose more profit than many other departments can save.

Why not put your power plant on the same efficient basis as the rest of your plant? Turn your power plant into a money-making institution. You can do it by installing

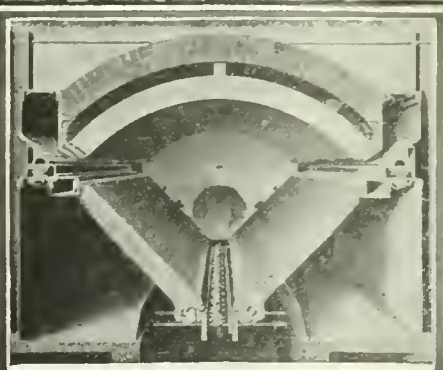
MURPHY AUTOMATIC FURNACES

Boilers fired by Murphy Automatic Furnaces are dividend payers. They are wonderful fuel and labor saving machines — machines that show up on the credit side of the ledger.

While, of course, Murphy Furnaces cannot put heat units into fuel, they can, however, get them all out. There is nothing like a fuel famine to drive home the fact that the Murphy Furnace burns fuels that would put other devices out of commission.

Murphy Furnaces bring a true form of economy to every plant. They operate on Natural Draft and *burn any fuel that has heat in it*. And for labor saving—Murphy Furnaces are so completely automatic in all their functions that they operate most efficiently when left alone.

If you want to catch the coal-pile thief and curb other boiler room losses, write us today. Catalog B-7 tells you what other plants are doing. Copy on request.



Factors Back of Every Installation of MURPHY FURNACES

Natural Draft—on everything except the most extreme peak loads. Will double the output of your boilers without one penny for draft.

Burn any fuel—This is the biggest possible feature for the engineer to consider at the present time.

Standard—The Murphy Furnace is staodard in design. All new features produced from time to time may be applied to any Murphy Furnace now in use.

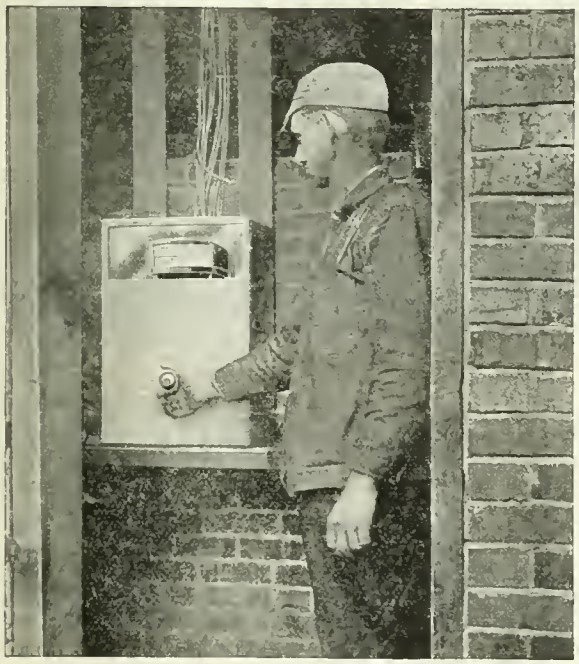
Smokelessness—The Murphy Furnace is designed to afford perfect combustion. The arch insures high furnace temperature which means that the air is preheated and admitted exactly where and when needed to give maximum efficiency.

Automatic Operation—The amount of fuel supplied may be regulated while in operation. Every detail for keeping a perfect fire is provided in the design and construction of the Murphy Furnace. The coal is supplied—the fire distributed evenly—the ash removed—continuously and automatically.

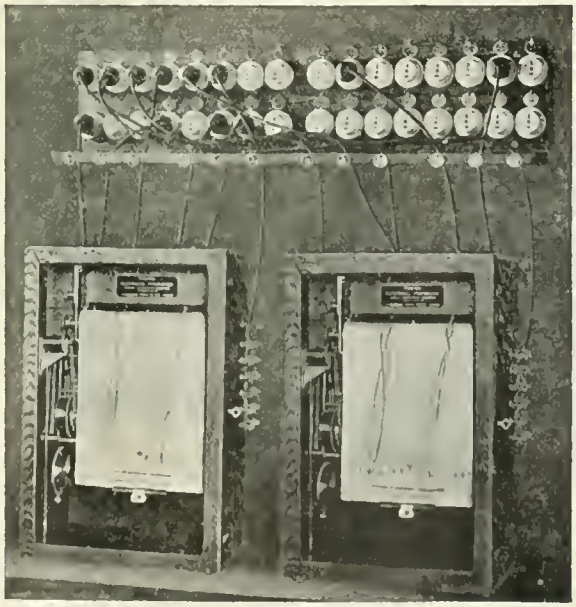
MURPHY IRON WORKS, Detroit, Michigan, U. S. A.

BURN ANY FUEL THAT HAS HEAT IN IT

THWING PYROMETERS
improve product and save fuel



Indicating Type



Multiple Recording Type

SIX months after you install Thwing Indicating and Reducing Pyrometers they ought to repay their cost in one or several ways.

They give continuous reliable information about heat conditions—give the manager a dependable means of detecting inattention or inexperience of the furnace attendant, assist in reasoning out undue fluctuations in quality of finished product and make possible standardization of heat treatment in repetitive operations.

Ideal heat conditions cannot be maintained without the aid of pyrometers, which should enable the manufacturer to decidedly increase the quantity and value of the output.

Guesswork being eliminated, perfect production in the shortest possible time becomes easily attainable.

Thwing Pyrometers also point the way to reduced fuel consumption. A 10 per cent saving in fuel is not uncommon, and we have cases on record where it is upwards of 30 per cent.

Thwing heat measuring and recording instruments cover a complete line of portable and wall instruments in various types and styles for use in steel mills, power plants, foundries, tool rooms, gas works, etc.

The details of an installation under given conditions involve individual engineering in each instance, so each outfit is sold with our full co-operation in choice of instruments, and with instructions for making the equipment thoroughly satisfactory.

Write for literature and prices, and ask for our engineering advice.

THWING INSTRUMENT COMPANY

3354 Lancaster Avenue **Philadelphia, Pa.**

78

PITTSBURGH PIPING SERVICE

—"What You Want When You Want It"—

SPECIAL CASTINGS

STEEL or IRON

From Our Own Foundries

FOR
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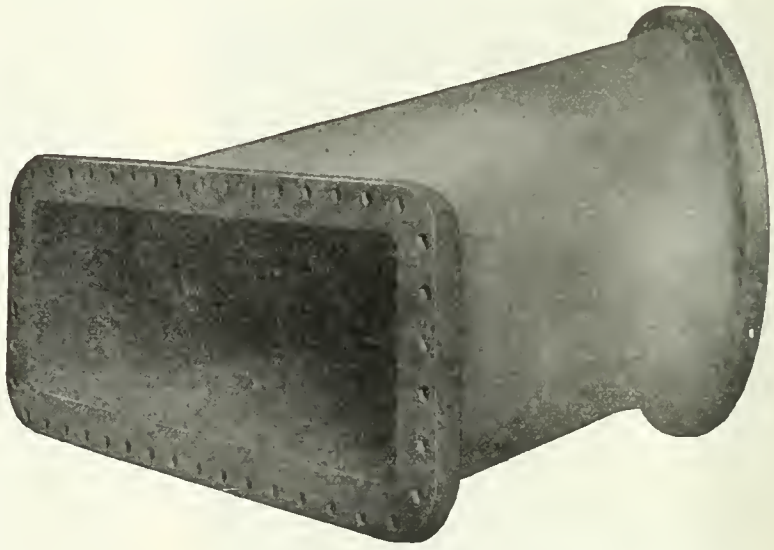

Special 48"—45° Elbow

PITTSBURGH PIPING & EQUIPMENT CO.

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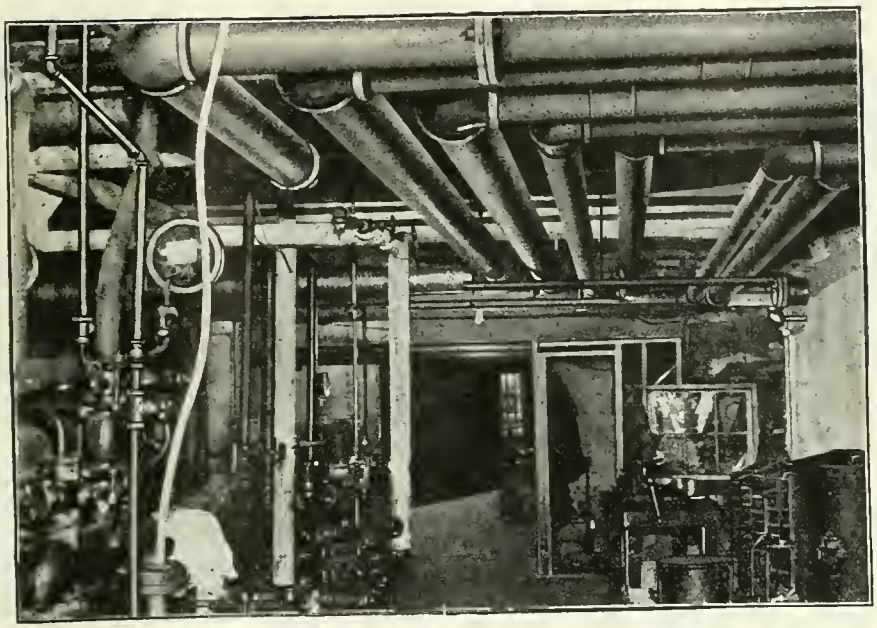

Engine-room of the Ambassador Hotel at Atlantic City, N. J. A Reading installation

Grit and sinews

It's sinews and general all around brawn that give a man power to work. But if he's to labor intensively under adverse conditions he must have an added store of endurance as well. That's where pure grit tells.

No man is ever worked as your pipes are. Throughout the year, day by day, they are racked and wrenched and pounded by terrific strains. Vibration, torsion, changes in temperature, all tax their powers to the utmost. And in addition your pipes must withstand the corrosive attacks of moisture, frost, brine, ammonia, and acid-impregnated air.

If a pipe is to win out under such conditions it must have sinews of iron. Reading Wrought Iron Pipe has those sinews in its tough resilient fibres. And it must have grit. Reading Wrought Iron Pipe has that also, in the shape of non-corrodible silicious slag, permeating it from its very birth in the puddle furnace.

New Handbook and Price List will be sent upon request

Specify Reading—the Pipe that Endures

READING IRON COMPANY, Reading, Pennsylvania

New York
Philadelphia
Boston
Pittsburgh

READING
WROUGHT IRON PIPE

Chicago
Cincinnati
Houston
Los Angeles

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Human Nature—

At a recent meeting of the Association of Iron & Steel Electrical Engineers a prominent Pittsburgh Engineer touched a fundamental truth when he said:

"A great many things in steel mill operation are possible, but are highly improbable."

This statement followed a lengthy discussion during which steam drive was made to compare favorably with electric drive under ideal conditions of steam operation. And to make his point more clear, this engineer said further—

"A steam or hydraulic lever can be worked as many times in a tu n as the handle of a master controller; but it is seldom done.

Long steam lines can be kept tight and thoroughly insulated; where is there such an example?

The valves of the various dr v-ing engines can be kept perfectly adjusted, but such conditions a e seldom, if ever, found in actual practice.

Roll pass design and friction loads can be studied by means of steam flow meters and indicator cards, but is such practice universal?

In all of the above, the electric drive is so simple that the corresponding points are looked after with a resultant saving over actual steam drive practice."

Westinghouse Electric & Manufacturing Co.

East Pittsburgh, Pa.

W WESTINGHOUSE ELECTRIC

Westinghouse

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Where Flexibility Is Needed—

FRANCKE
FLEXIBLE COUPLINGS

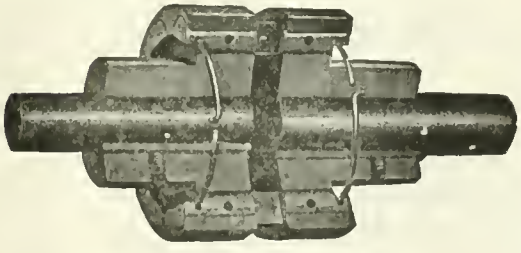
For Direct-Connected Machines

Shocks, jars, vibration, sudden load changes, cannot injure the electrical end of a **Francke** coupled direct-driven unit.

The flexible steel pin units of the **Francke** absorb the shocks—prevent them from injuring the windings of the motor.

And if there is any mis-alignment between the shafts, the **Francke** provides for it—preventing excessive bearing friction by permitting each shaft to run free in its own two bearings.

Write for Bulletin 26.



Where Rigidity Is Essential—

PINTITE
RIGID COUPLINGS

For Line Shafting

You can't mount a **Pintite** Coupling wrong. You can't make an insecure or unsafe shaft connection with it, if you follow directions.

Everything is made ready for you—coupling bored, pin holes drilled, pins made the right diameter and length.

All you need is a hammer—to drive the pins home. The job is done.

And after that—well, nothing can break or loosen a **Pintite** Connection that would not also spring and injure your line shaft.

Shall we send Bulletin 102?

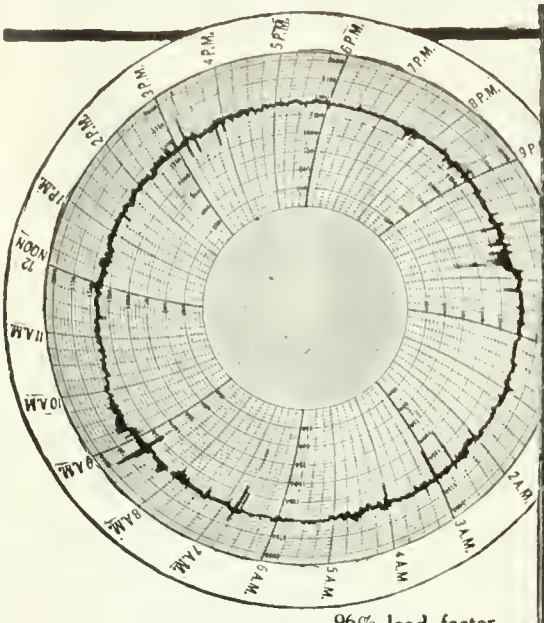
Probably our experience would help you eliminate your shaft coupling troubles. We've installed couplings aggregating over two and a quarter million horsepower. Ask us.

SMITH AND SERRELL

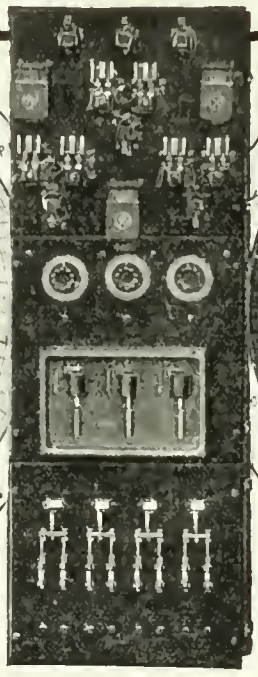
34 Central Ave. Newark, N. J.

Co-operate:—Refer to The Blast Furnace and Steel Plant

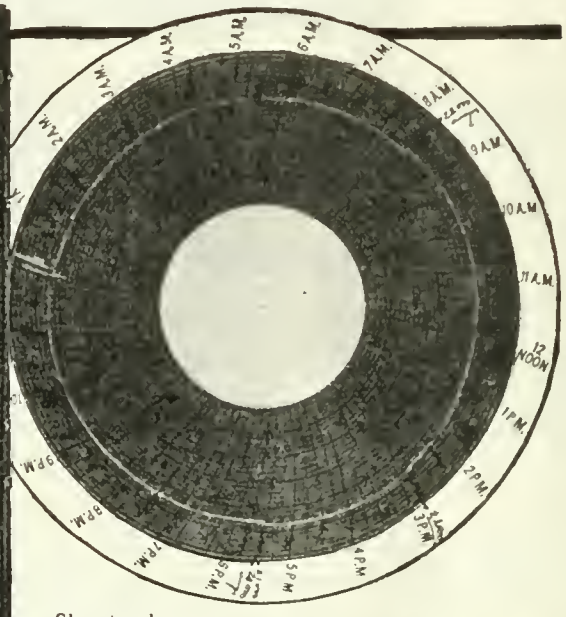
Steel, abrasives, carbides and ferro-alloys are most efficiently produced in electric arc furnaces having close power input regulation



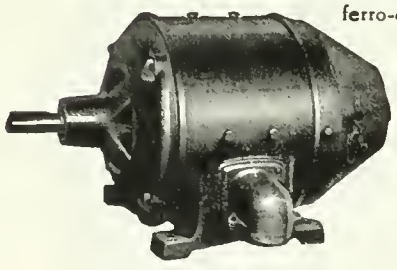
96% load factor was secured on an electric arc furnace making ferro-chrome.



A perfect furnace control for most efficient production.



Showing the perfect control of large calcium carbide furnace.



Electrode Motor

THE above charts show the perfect control of power obtained by using the G-E Automatic Electrode Regulator.

Transformer

Increase the output of steel, ferro-alloys or abrasives, etc., from your electric arc furnace by using a

G-E Automatic Electrode Regulator

Its simplicity of operation and sturdy construction, due to the use of standard well-tried parts, insure a minimum of attention and repairs, with attendant freedom from interruptions in the operation of the furnace which it controls.

Our specialists will be pleased to consult with you concerning the application of this equipment. Address Power and Mining Department.

General Electric Company

General Office Schenectady, N.Y.

Sales Offices in all large cities

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The Blast Furnace and Steel Plant

The Blast Furnace and Steel Plant

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VOL. VIII. JULY, 1920 No. 7

Table of Contents

	Page
INSPECTION OF TRUMBULL STEEL COMPANY PLANT — BY DONALD N. WATKINS.	393
THE DEVELOPMENT OF FLUE DUST BRIQUETTING — BY ALBERT L. STILLMAN.	395
DESIGN AND USE OF WATER COOLED FLOORS — BY W. H. MELANEY.	399
COLUMBIA STEEL COMPANY'S NEW PLANT	401
DESIGN OF EXPERIMENTAL ROLLING MILL—PART II — BY W. B. SKINKLE.	404
MODERN METHOD OF MANUFACTURING PIG IRON — BY LAWRENCE L. ARNOLD.	408
HEATING FURNACES AND ANNEALING FURNACES PART XIX — BY W. TRINKS.	410
PIPELESS PRODUCTS FROM ANNULAR BLOOMS — BY C. A. WITTEN.	414
OPERATING BY POWDERED COAL TO SAVE FUEL — BY A. G. COLE.	417
WELFARE WORK IN THE STEEL INDUSTRY — BY C. L. CLOSE.	418
INDUSTRIAL RELATIONS	422
FOREIGN RELATIONS	423
PRODUCTION TOPICS	424
OPEN HEARTH	426
NEWS OF THE PLANT	428
SOME POINTER ON BY-PRODUCTS	430
WITH THE EQUIPMENT MANUFACTURERS	431
TRADE NOTES, TRADE PUBLICATIONS	432

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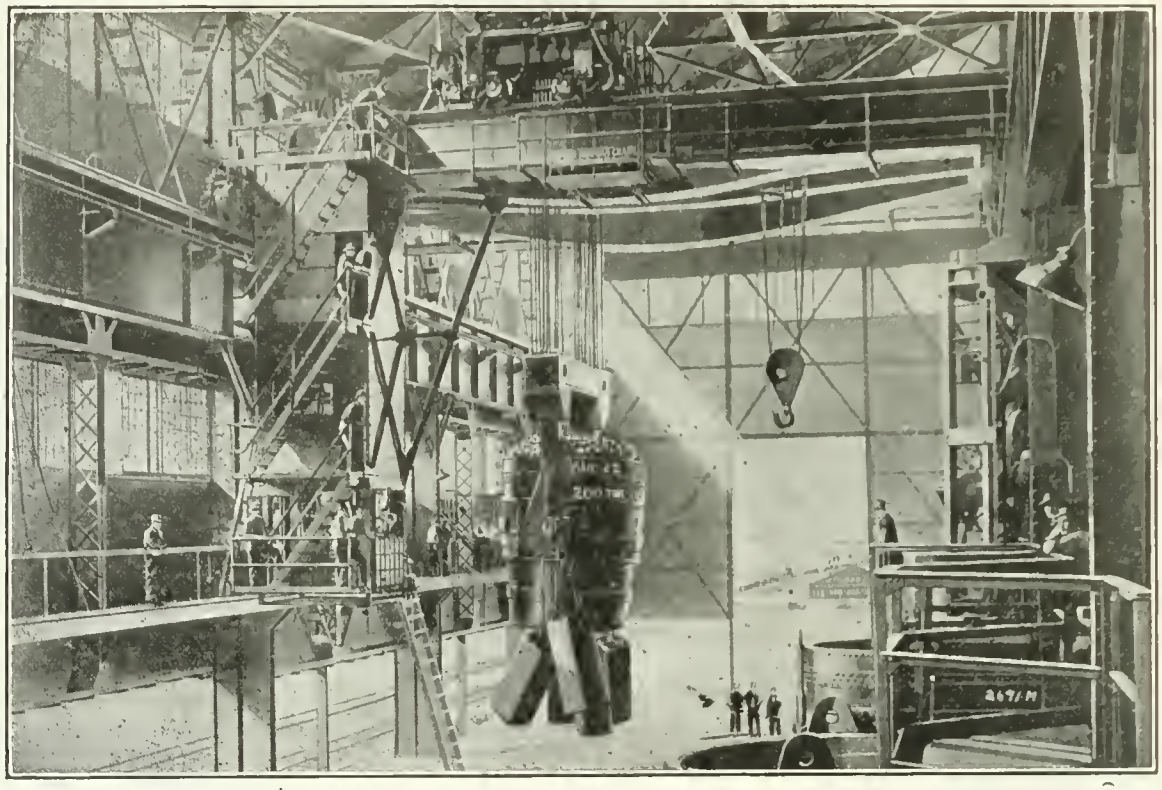
MORGAN EQUIPMENT

THE WORLD'S STANDARD



Where Correct Design and Strength Means Safety

A Morgan 150-Ton 4-Girder Type Ladle Crane Handling a Test Load of 200 Tons.

Two of this type designed and built for the Inland Steel Company, Indiana Harbor, Ind.

Morgan 4-Girder Type Ladle Cranes have every modern feature including main hoist of the two motor twin interlocking drum type equipped with our Patented Mechanical Equalizing Mechanism for equalizing the load on the hoist motors in both the hoisting and lowering directions.

In working out your crane problems, we will gladly place our time and experience at your disposal. Call on us—We can help you.

THE MORGAN ENGINEERING COMPANY

PITTSBURGH, PA., Oliver Building

BIRMINGHAM, ALA., American Trust Bldg.

ALLIANCE, OHIO, U.S.A.

NEW YORK, 120 Broadway

CHICAGO, 122 So. Michigan Ave.

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The Blast Furnace and Steel Plant

VOL. VIII. PITTSBURGH, PA., JULY, 1920. No. 7.

Inspection of Trumbull Steel Company Plant

Pittsburgh and Cleveland District Sections of the Association of Iron and Steel Electrical Engineers Visit Warren, Ohio, on an Inspection Trip of the Trumbull Steel Company's Plant.

By DONALD N. WATKINS.

ABOUT 500 members of the Association of Iron and Steel Electrical Engineers and their steel plant friends left on a special train over the P. & L. E. railroad on the morning of June 26, 1920, for an inspection tour of the Trumbull Steel Company's plant at Warren, O.

The special train of seven coaches left Pittsburgh at 9 a. m. and arrived at Warren at 11:15 a. m. On reaching Warren, the train was moved over the Trumbull Steel Company's siding until the main office building was reached. After leaving the train all the visitors were assembled on the lawn directly in front of the office building and their picture was taken. Immediately following this, the visitors retired to the White warehouse, where luncheon was served. After lunch the guests were separated into units of about 10 persons. Each unit was furnished a guide and the inspection of the plant was started.

On leaving the warehouse the hospital and storeroom were first inspected. From there, the tin house and annealing building, the pickling building and the shear floor and hot mill building were visited in the order mentioned. In the hot mill building was found 34 mills, 13 of which were driven by a 2,000 hp 61 rpm Mesta engine, 13 by a 2,000 hp 61 rpm Tod engine, and four sheet and four jobbing mills driven by a 1,800 hp 200 rpm slip ring induction motor. Alongside of this building was a new filter house under construction, which is to furnish water for the water cooled standings, roll necks for the strip mills and boiler feed water. Following was a 1,200 ft. building for the new 14 inch continuous strip mill, which is under construction. This mill is to be driven by two 1,250 hp and four 800 hp dc motors. These motors will receive 500 volts from two 3,300 kw synchronous motor generator sets, each having a separate unit. The product of this mill is to be 30 foot bars of various weights. Parallel to the 14 inch mill is another new building under construction, which will house the 9 inch hot strip mill. This mill is also to be driven by three 1,200 hp motors with scherbious control. Then we proceeded to No. 1 substation. Here 22,000 volts are received, 3 phase 60 cycle coming through the second floor to nine 2,000 kva transformers connected delta-delta. Power is then delivered through another set of oil C/B to a main bus at 2,200 volts, then through a high capacity 15,000 volt full automatic oil C/B without low voltage trip to the sectionalized bus, then through disconnects to lead cables to different motor rooms through 4½ inch O. D. fiber conduit. The cable used is 7,000 volt 3 conductor varnished insulation 500,000 cm.

Next the cold strip mill was visited. Located here was a new dc power station with a present capacity of 3,500 kw dc and 5,000 kw will be added in the near future with a 1,200 kva synchronous condenser for power factor connection. The present dc load in this department averages 5,000 amperes and frequent 7,500 ampere peaks but with present increase will average 12,000 amperes with peaks of about 15,000 amperes. The generator bus consists of 12 pieces of ¼x5 inch copper and tapers off to six pieces for the lower end of the distributing switch panels. The cold strip mills present equipment consists of 8x10 inch, 12x16 inch and 16x20 inch tandem mills together with the necessary single mills, combination mills, slitters, shears, levels and oil machines. The capacity of this mill will shortly be doubled when a 20x24 inch tandem mill, a 16x20 inch tandem mill, an 8x10 inch tandem mill with two 8 inch combination mills, three 8 inch single mills, three 12 inch single mills and one 12x20 inch single mill with auxiliary apparatus will be installed. In connection with the cold strip mill is the annealing department where the steel is placed on bottoms covered, annealed and cooled in the presence of coke gas, for which a producer is used.

Next in order the steel works department was visited. An 18 inch Morgan mill driven by a 3,500 hp 93 rpm slip ring induction motor, and a 21 inch Morgan mill driven by a duplicate motor were passed by on the way to the blooming mills. Here a 5,000 hp reversing motor 0-40-120 rpm was driving a 36 inch reversing United Engineering Company's blooming mill. This mill rolls at the rate of 60 ingots per hour, 20 x 22 inch ingots weighing 6,700 pounds are broken down to 6¾x6¾ inch blooms. Twenty-four gas heated pits heat the ingots for this mill. All valves and covers on these pits are electrically operated.

The open hearths were then visited. Here were found seven 100-ton furnaces with all equipment such as valves, doors, draft fans, all electrically operated. Included in the equipment are ladle cranes with 175 main and 40-ton auxiliary hoists. All together there are 839 motors installed in the plant with a total of 36,043 hp. The power consumed in 1919 was 50,000,000 kwh.

Leaving the plant at 5 p. m., the visitors were then taken on a special train to Youngstown, O., where a banquet was served at the Ohio Hotel, covers being laid for 650 people. Following the banquet a technical session

was held. A very interesting paper on "Electric Drives for Band Mills," was presented by A. W. Mohrman, electrical superintendent of the strip department of the Trumbull Steel Company. Mr. Mohrman during the course of his remarks said:

Here the writer will discuss the conditions as they appear on a special built, semi-continuous mill for rolling bands. The mill is arranged with 10 stands of rolls, which are driven by 3 variable speed slip ring induction motors, one 1,500 hp, and three 1,200 hp, each controlled by 650 kva Scherbius system, with speed regulation from 270 to 450 rpm, and synchronous speed being at 360 rpm.

The first 5 stands are driven by being connected by gears to a common shaft, which is gear connected to a 1,500 hp slip ring motor. This end of the mill is usually known as the roughing train, next in the finishing end, No. 6 is driven by a 1,200 hp motor, Nos. 7 and 8 are coupled together, and are driven by another 1,200 hp motor; No. 9 is so arranged that it may be either connected to No. 6 or No. 10. No. 10 being the finishing stand, is driven by a 1,200 hp motor, and is so connected that the top roll is run by friction, which gives the required finish so hard to obtain.

The writer can, from personal experience, with this type of mill state that it is very flexible, and is able to perform the proper functions for any size within the limits of the mill, for within a year the 52,458 net tons rolled consisted of 3,889 different sizes ranging from 10 to 90 per cent of the width of the roll and from .050 inches up to approximately .75 inches in thickness.

For jobbing facilities it cannot be beaten, for it often happens that orders come by wire as rush orders, which are often rolled, and in the shippers hands before the order has gone through the customers office routine, and the shipper must wire the customer for shipping instructions. The speed of the miss must be so arranged that the delivery speed of one mill is the entry speed of the next in order to prevent looping or pulling tight, either of which is objectionable. Where the loops are greater than 12 to 20 inches there is a danger of the strip doubling up, and entering the next mill and stalling or breaking the rolls. When this happens a number of cobbles are caused, and a great amount of time is lost in rearranging the mill. If the steel pulls tight it ruins the product, often causing the piece to stick in the rolls.

It may appear that these points mentioned have nothing to do with the drive, yet indirectly they have, for an uneven temperature affects the elongation, and as a result the speed must be changed, for the harder the steel the more power it takes to roll. Therefore the characteristics of the drive must be such that sudden loads of from no load to 125 per cent full load will affect the speed but slightly. There must be incorporated with the control such devices that will enable the speed to be changed instantaneously regardless of the load.

Cold strip rolling is only further developing the steel by rolling cold, this is usually done on mills of slow speed, with four mills arranged in tandem. Here the speed need not be so closely regulated as in hot strip rolling, although the closer degree of stability, the better are rolling conditions as well as the product. In cold strip rolling the loop is objectionable, although it can be carried away manually, but when the metal drags on the floor it picks up foreign substances and carries it through the next roll, and often ruins the roll of product. When the steel pulls tight there is danger of it scoring the roll or breaking, when it breaks, it will only have to be re-entered and rolling continued.

Now that we have an insight of the rolling conditions, the writer will attempt to apply the drive. In the single speed drives there is little for the drive to do except to keep moving, for the elongation is compensated for by the draft setting and the speed advancement obtained by different gear proportions although in some cases, the mills are provided with special looping devices.

In the singe speed mills which may be driven by either dc shunt, compound or induction motors, as a matter of fact when the hp required is low the dc motor seems to fill the requirements, but when the hp needed is over 1,000 hp, alternating current is used in the majority of cases, thus the induction motor is the universal motor. The cost of installation goes up with the hp on dc machines, due to the large motor generator equipment required, the ac motor has usually been given the preference. When the mills are all connected to a common shaft, the speed regulation is eliminated; if the drive slows down, the whole mill slows down in unison, therefore, reliability, simplicity, and the productive ability are the only requirements considered.

The variable speed mill seems to be the mill of greatest interest today, owing to its jobbing characteristics, and rush delivery of product.

On this type of mill something more valuable than single speed motors are required, for if the entire mill would have to be changed each time the order is changed, it would be slow work, for it is nothing to change an order from 7 to 15 times in a single turn of 12 hours. Therefore, by having a variable speed drive, as is often the case, all changes take place on the last two stands. So closely are speed regulation, flexibility and simplicity related that if one were left out, the entire installation would be a failure. Shunt or compound motors are often used to drive these mills with great success, nevertheless, the speed-torque of the induction motor has been greatly considered for variable speed mills, even in the continuous type where each mill is provided with individual drive. In some types of variable speed mills the two speed slip ring motor has been used, rheostatic control on induction motors has been considered, but rejected due to its series.

In a majority of cases, variable speed motors, with special designed control equipment have been installed. Inasmuch as the shunt motor can be built with speed regulation that is within 1/20 of 1 per cent by involving some secondary equipment, within its control, so it is possible to install within the secondary of an ordinary slip ring motor, such equipment that will give practically constant speed adjustment. All of the secondary energy is not dissipated in heat, a portion is returned for useful work; this is generally accomplished by two systems, namely, the Scherbius and the Rotary converter. Both closely meet the requirement of the variable speed mills, and both have been in operation for several years. In the Scherbius system a polyphases commutating motor shunt field excitation, commonly known as the regulating motor, is connected across the slip rings of the induction motor to be controlled, and is direct connected by shaft to an induction generator, which acts as a squirrel cage motor in starting. In the regulating set the counter emf of the regulating motor opposes the voltage across the slip rings, and by varying the excitation of the regulating motor the slip ring voltage opposite its counter emf must increase or decrease, and in bringing this about the main mill motor must either rise or fall in speed, because of the shunt excitation of the regulating motor and its cemf. The speed of the main mill motor remains practically constant throughout the entire range of load, for any speed setting of the control, and as before stated the slip energy is returned to the line, less the loss in motor generation.

The Scherbius system is built in two forms, the single and double range. Of these the latter is better adapted for hand mill use. The double range is better and more efficient, for the reason that if for some reason, the control is down for repairs, the main mill motor can be run at synchronous speed, and this speed compensated for by the other drives.

The Rotary converter system while similar to the Scherbius system in principal, has many detrimental features, as very little is to be gained in the first cost, and on account of the speed being only on one side of synchronism. When the question arises as to which is best, the answer is either depending on the special requirements of the mill.

The Scherbius system, because of its many advantages over any other is generally used; briefly, they are: High efficiency, lower first cost except in special cases, overland capacity at any speed setting, synchronous speed being between maximum and minimum speed, and power factor correction without added complication.

Therefore, it must be concluded that the drive that fills the requirements of the mill in question is the drive required, and when all points are summed up the result will be an electric drive.

Following the technical session the visitors returned to their special train for Pittsburgh and arrived at the P. & L. E. depot at 11:30 p. m., after having completed the most successful trip ever undertaken by the Association of Iron and Steel Electrical Engineers.

The Development of Flue Dust Briquetting

Thorough Review of Process Offering Efficient Treatment, Simple Mechanism and Low Cost for the Recovery of Iron From Flue Dust for Blast Furnaces.

By ALBERT L. STILLMAN,
Vice President, General Briquetting Company.

IT IS well known that the iron ore supply today contains a far greater percentage of fines than that of two decades ago. Further, the proportion of fines to lump is constantly increasing, due to the continued gain in production of Mesabi ores. The use of high pressure blast and heavier burden—the practice of late years—has tended to accentuate rather than relieve the condition. The production of troublesome flue dust has, therefore been increased for more reasons than one, and the recovery of the iron in this dust has formed the subject matter for long investigation, both here and abroad.

The return of the dust to the furnace, as such, has met with little favor. It is today the consensus of opinion that the dust should be agglomerated before return to the smelting operation, either by sintering or by briquetting.

Fine material from the blast furnace is now commonly divided under three heads:

Dry dust which is the usual by-product of blast furnace production—the material we commonly associate with the term "Blast Furnace Flue Dust." It is collected in the dust chambers at most blast furnace plants.

Wet Dust—The very fine mud which is the product of the various wet methods of flue gas cleaning. The cleaning has been necessitated by gas engine requirements.

Filter Dust—The product of dry cleaning of blast furnace flue gas, as by the Kling Weidling method after the coarser dust is removed. It has the consistency of flour.

It is of primary importance that any method adapted for the treatment of flue and filter dust from a modern blast furnace should be efficient in its treatment of each and every form.

The second requirement of hardly less importance is simplicity. There is little room in blast furnace operation for complicated mechanism; and the third requirement, that of low cost, is self-evident.

Certain processes of sintering have met with favor in the United States. Briefly, sintering is a reducing process, wherein the iron bearing material is intimately mixed with the amount of carbon required. The mixture is moistened, set in a uniform layer, surface ignited, and submitted to a current of air. By the combustion of the carbon and the resultant heat, the iron bearing material is agglomerated into a more or less coherent mass. It is claimed that this sinter contains iron, partly metallic and partly as oxide. It is further claimed that the future activity has been benefitted by the sintering.

Search for simplicity has resulted in the establishment of two briquetting plants by blast furnace engineers in the city of Buffalo, one at the Wickwire Steel Company, and the other by the Buffalo Slag Company. They have recognized that flue dust is ideal blast furnace feed, except for its very finely divided condition. Consequently if it were pressed into bricks or briquettes, sufficiently strong to retain their shape to the melting zone, the entire difficulty would be easily and cheaply solved.

The chief difficulty encountered in the early experiments in briquetting was the expense. Without binder a very high pressure had to be used, only possible on the best hydraulic machinery. This pressure was found to be somewhere in the neighborhood of 20,000 pounds per square inch, and its cost ran as high as $4.00 to $5.00 per ton.

On the other hand, briquetting with even the cheapest binders at low pressures, provided a binder expense of well over $1.00 per ton; in fact the only successful briquetting plant for blast furnace flue dust using binder was in a European location adjacent to a paper mill, where cheap sulphite pitch residue was available. However, low cost briquetting at comparatively low pressures was secured by the discovery of the Schumacher catalytic process in 1908.

In brief the Schumacher process rests upon the discovery that certain salts have a catalytic action upon blast furnace flue dust, as expressed by Dr. Schumacher himself "that develop the latent setting

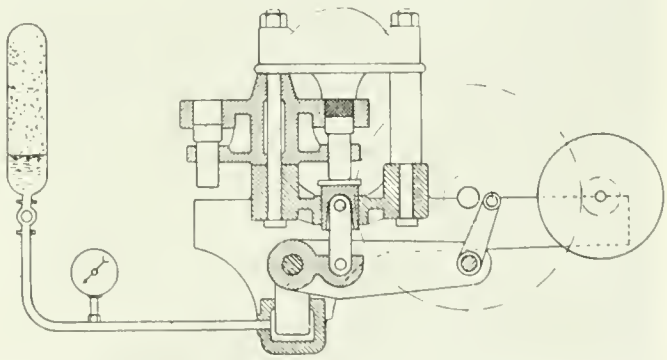


Fig. 1—Diagram showing toggle action of F. E. press.

power." The chemistry of the Schumacher process is ably discussed by Prof. Joseph W. Richards, of Lehigh University in a paper before the American Institute of Mining Engineers, February, 1912. The term catalytic is necessarily a wide one. Applied to the science of briquetting it means simply a re-agent, which, having no binding quality itself, can set up a binding action in other materials. Thus calcium chloride and ferrous sulphate in solution added with the proper percentage of water to blast furnace flue dust, causes this phenomenon. The first practice used calcium or magnesium chloride, as it was considered detrimental to add any compounds of sulphur in blast furnace operation. Later investigation proved that the action of ferrous sulphate gave the most desirable result at the lowest cost, and the amount of sulphur involved being so small—and in sulphate form at that—no ill results were noted; consequently the practice today established in the United States, is to use the crystalline ferrous sulphate dissolved in

water, the addition being one-half of 1 per cent figured to the basis, the water addition being 10 per cent of the total.

The chemistry of the process probably involves the breaking up of the ferrous sulphate, forming a ferrous-hydroxide and sulphuric acid. In the presence of oxygen the ferrous hydroxide becomes ferric, and the sulphuric acid formed attacks the ferrous oxide of the flue dust forming a ferrous sulphate anew, which continues the cycle. The action is exo-thermic, and a large quantity of heat is evolved.

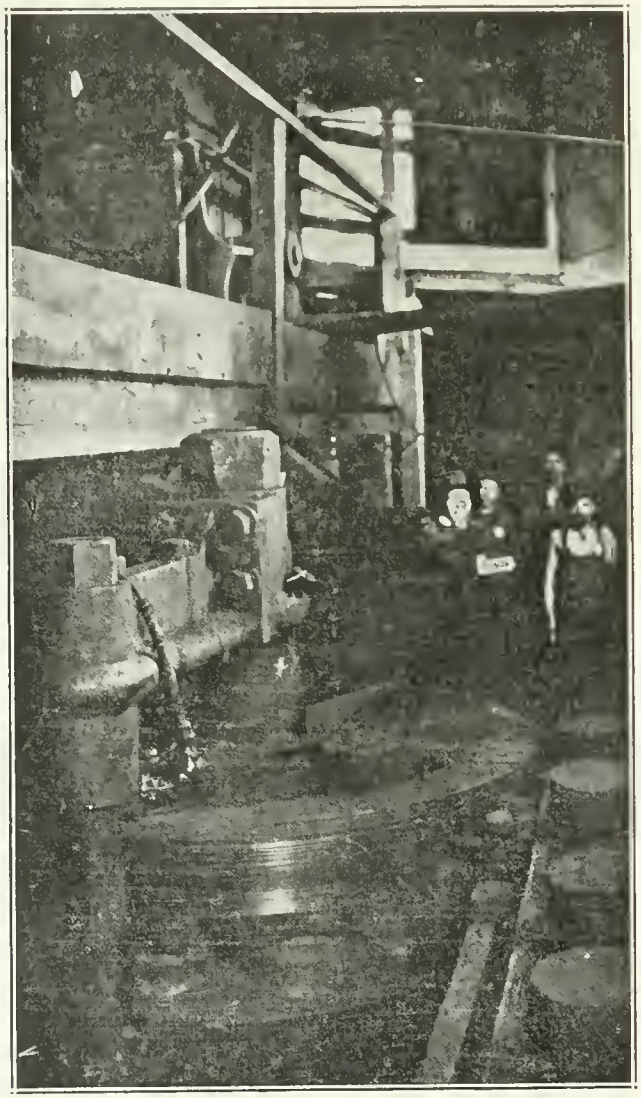


Fig. 2—Wickwire Steel Company press delivering briquettes. Discharge in foreground—Feed tub in front.

In the subsequent drying the ferric hydroxide sets in a horn-like substance, as mentioned by Prof. Richards. At this point it is probably the normal hematite, or Fe_2O_3. At all events, assisted by pressure and subsequent drying an extremely hard and durable briquette is formed.

A very considerable research was made to determine at what pressure the best results would be obtained. It was, of course, desirable to avoid the use of hydraulic eqiupment. Entirely satisfactory results were obtained at a pressure of 8,000 pounds per square inch. This pressure can be obtained on a carefully constructed toggle press.

This press is of toggle action, designed for the high and uniform pressure requisite to metallurgical briquetting. Its operation is automatic, and its control simple. The design embodies great strength, and the elimination of operating delays. The appreciable wear and tear is confined to the mold liners and the wearing plates, which are readily renewed.

A double girder bed-plate with cross girders serves as the lower platen. The upper platen is held in position by two tie bolts and separators, one of which serves as the journal or axis about which the mold and plunger platen revolves. This platen has sockets containing cylindrical mold liners, each being provided with a plunger serving as a bottom for the mold, the upper side of the mold being sealed at the pressing position by a compression block attached to the upper platen.

The main plunger mounted in the lower platen between the two tie bolts, engages each of the table plungers successively. Power is transmitted through a connecting strap by the main toggle lever, the fulcrum of which is carried by an oil cylinder piston mounted between the double girders of the press. The only outlet from this cylinder is connected to a nitrogen gas flask. The nitrogen column serves as a cushion absorbing excess pressure if the mold is overloaded, and in effect insures absolutely uniform pressure on the material to be briquetted, regardless of the amount of material in the mold. The most suitable pressure for any material can be applied by varying the initial pressure in the nitrogen flask. A small oil pump is used to change working pressure. A hydraulic gauge records the working pressure up to 10,000 pounds.

The swivel end of the toggle lever is connected to a crank shaft actuated by a belt drive through heavy gears mounted on the two press girders. Fig. 1 illustrates the combination described above.

The mold platen is driven by means of a "Geneva" movement. It is locked in position during the mold filling, pressing, and briquette discharge operations. The feed box is mounted on a stand, directly over the table; the molds are filled as they come into position under it by a set of revolving paddles.

The mechanism for discharging the briquettes from the molds consists of an auxiliary plunger mounted in a side frame which is actuated through a connecting strap by a bell crank, which is in turn actuated by means of a connecting rod provided with a spring take-up attached to one of the main driving gears. This auxiliary plunger engages in succession the mold plungers, forcing the briquette up until it clears the mold. The briquette is then pushed from the top of the mold plunger to the space between the molds by a crosshead. Motion for the crosshead is obtained from a bell crank and cam arrangement mounted on the main driving gear. A swinging paddle mounted on the feed box sweeps the briquettes from the platen to the conveying belt. Fig. 2 and 3.

In case foreign material (such as railroad spikes, etc.) enters the mold, an accident is prevented by the oil and nitrogen cushion, and by a shearing plate provided in the safety compression block, which comes into play if the oil plunger is forced to its limit. The belt drive is relied upon as a further precaution and shear pins are provided in the table drive.

About 30 net hp is required to operate the press. The speed is from 175 to 200 rpm. The hourly ca-

pacity will vary from 6 to 10 tons, depending on the specific gravity of the material briquetted.

At the Wickwire Steel Company's plant, the dust is loaded in cars at the stock pile and carried on a trestle over the plant. The cars dump the dust on a grizzly where the lump coke is held back and returned. The dust passing through the grizzly goes to the feed bin, and is fed thence to the mixing table. Here 10 per cent solution of coperas, containing one-half of 1 per cent of the salt (dry) is added. Thorough mixing of the dust and catalytic solution is obtained in the succeeding operation, kneading in a horizontal trough paddle mixer. Here the chemical action begins. From the paddle mixer the mixture goes to a tub mixer, which serves as a feed to the press, above described. The chemical action of the process is well under way as the briquettes are molded in the press, the next step in the operation. From the press the green briquettes are carried on a traveling belt to a storage room, where they are seasoned for 24 hours, when they are in condition for smelting.

At the Wickwire plant briquettes, when used, form 10-15 per cent of the furnace charge.

When the Buffalo Slag Company plant was installed it was anticipated that sooner or later, the call to treat wet dust in conjunction with the dry would come. This anticipation led to certain modifications of design.

The dust is delivered in cars and screened as at the Wickwire plant. There are two feed bins, each adapted to deliver a measured quantity of material. One of these was to receive the wet dust. However, the wet dust has not as yet appeared. The mixing can be so arranged when it does appear that the moisture in the wet dust will replace a large part of the water of the copperas solution. The copperas would then be added in concentrated instead of dilute form. In this event more intimate digestion of the dust with its catalytic was deemed desirable. The feeding tables appear in duplicate, one for each bin, and discharge into the horizontal trough paddle mixer as at Wickwire, wherein the added copperas is thoroughly admixed. Immediately after this point a notable modification in design occurs.

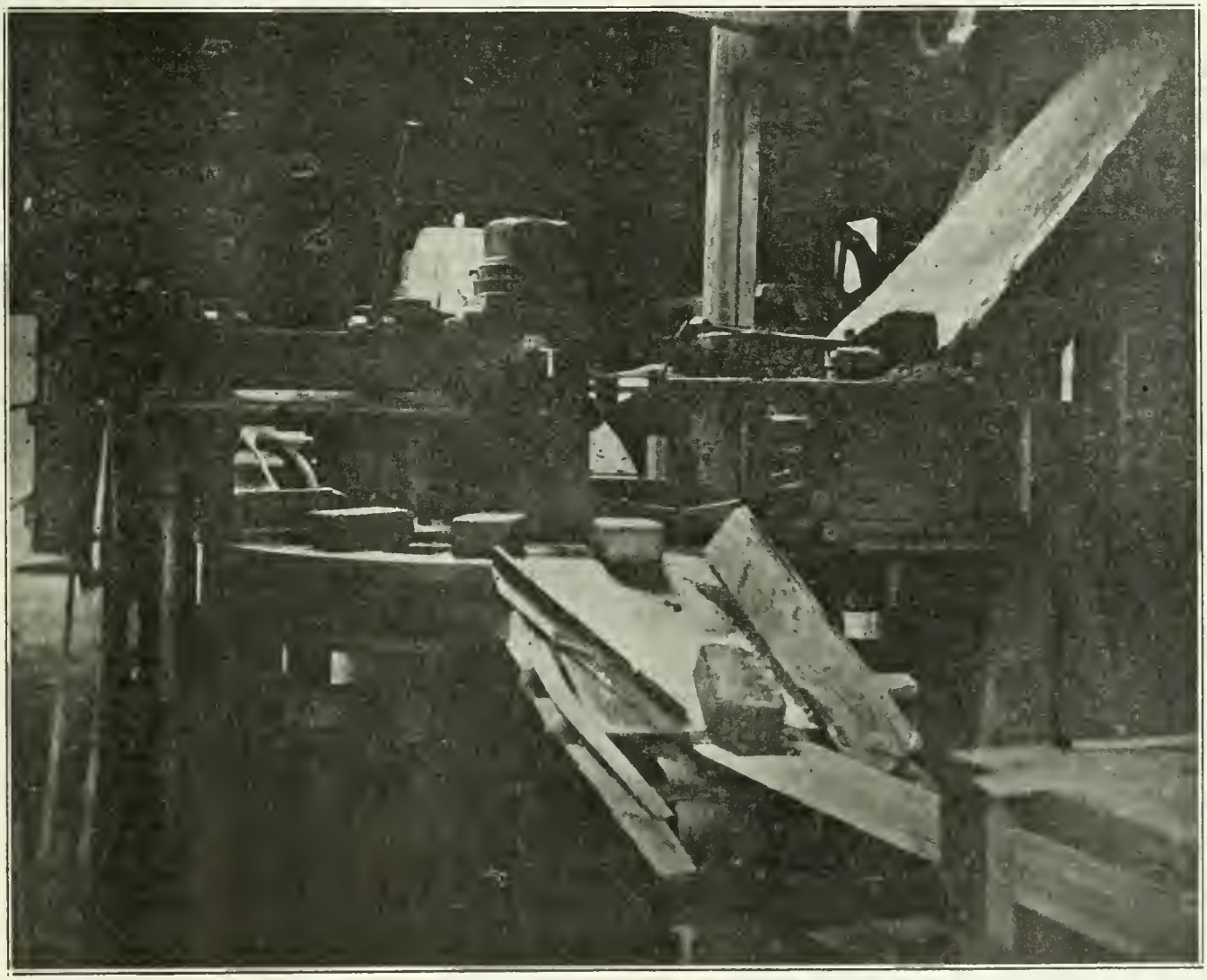


Fig. 3—F. E. press in operation delivering briquettes, Buffalo Slag Company plant.

The mixed flux of dust and solution is fed from the paddle mixer into the pan of a General Briquetting Company masticator. This machine is a greatly improved edge-runner of pan grinder with stationary pan and huge movable rolls with scrapers in the sectors between them. See Fig. 4. The rolls are 48 inches diameter and 30 inches wide. The body or core of the rolls are ordinary gray cast iron. The

rims or tires are a special mixture, hard white iron of great wear resisting quality. Two cast iron arms which project across the table on opposite sides at right angles to the axis of rolls are bolted to the driving head. These arms carry the adjustable plows mentioned above and are shown on the plan view of the machine. The base or bed is cast in one piece and reinforced. The wearing plates are renewable. The drive frame consists of two heavy "A" shaped cast iron side frames rigidly bolted to the bed plates. These are connected at the top with a cross girder. The masticator is compound geared, and requires 40 horsepower.

The mastication, and by that is meant the digestion of the flue dust with its admixture, has proven of utmost importance. Although the masticator was originally installed with the idea of treating wet pulp from the gas washers in conjunction with the dry dust, the event proved a highly increased efficiency of binding power but obtained when (as the continued practice of the Buffalo plant came to be) only dry dust was treated. The flue dust at all times, whether medicated or not, has a high latent setting power, which the addition of catalytic develops. So high is this bond under normal conditions that an excellent briquette can be made, using 30 parts of flue dust and 70 parts inert material—fine hematite ore for instance (which possesses no latent cementing power), or coke. Frequently large portions of unconsumed coke in fine condition are received in the flue dust, to be incorporated into the briquettes, subsequently realizing to the full their reducing value in the blast furnace—certainly the only method by which fine coke can be so utilized. It has been found that the mastication increases perceptibly this carrying ability of the flue dust, and permits a greater degree of admixture of inert material. Then, too, by mastication the combined breaking of the dust particles together with the better diffusion of the copperas solution produce a more rapid and efficient chemical action.

The use of the masticator on flue dust, especially the incorporation of wet pulp from the gas cleaners with the dry dust, is covered by U. S. patent 1,312,218, August 5, 1919, issued to Felix A. Vogel.

From the masticator the flux, thoroughly digested, is conveyed to the press. The molds of the press at the Buffalo Slag Company's plant turn out brick-shaped briquettes 5¼x8¾x3 inches. From the press the briquettes go to 24 hours' storage and are then returned to the Buffalo Union Furnace.

To summarize, all blast furnace men recognize the advantage of agglomerating their fine materials for, whatever the method, such agglomeration increases the regularity of furnace operation; increases the metal produced; decreases the coke consumption and dust production, and through the combination of these factors lessen the cost of producing pig iron. To achieve the proper agglomeration, briquetting by the Schumacher process has the following claims:

1. The briquetting plant is the lowest in first cost of all known process of agglomeration.

2. The briquettes cost less per ton to produce than any other agglomerate.

3. Briquettes give maximum yield from the coke and flux of the flue dust. As they are returned to the blast furnace in their original form all their reducing value and contained heat do useful work.

4. Briquettes have 25 per cent porosity, giving the proper heat transfer.

5. Briquettes have no silicates nor glazed surfaces. The iron is in the most easily reducible form.

6. Briquettes are strong. Professor Richards found a minimum of 445 pounds per square inch compression resistance in his test. Properly seasoned they stand handling well. They hold together in the furnace. Briquettes placed in the stove and subjected to blast furnace temperature held their shape, and when withdrawn proved to be sponge iron. See Fig. 13.

7. Combined with the Vogel preliminary mastication, briquetting forms the only solution to the problem of returning wet pulp from the gas cleaners to the blast furnace. The wet pulp masticated with dry flue dust makes excellent briquettes.

8. Combined with the Vogel preliminary mastication, briquetting is the answer to the problem of treatment of the dust produced by dry gas cleaning as from the Kling Weidling filters. It has heretofore been extremely difficult to "wet down" this dust as it is so fine that water will not, of its own weight penetrate the mass. The mastication forces the penetration of sulphate solution, and the resulting cementation is excellent.

9. Briquetting fine ore with flue dust is an excellent method of preventing the formation of too great a burden of fine dust.

10. Briquetting is the simplest method of disposing of flue dust. It requires no fires, no heating, no highly skilled labor, no close technical supervision.

The experience in Buffalo is significant. The results at Wickwire and Buffalo slag indicate great expansion of briquetting practice as applied to blast furnace flue dust in the near future.

NUT COKE USED IN BLAST FURNACE.

At the regular bi-monthly meeting the Southern Ohio Pig Iron and Coke Association, attended by representatives of blast furnaces and coke producers operating in the Ashland, Ky., Ironton, Portsmouth, Hanging Rock, Jackson-Wellston, Hamilton and Columbus districts, a very interesting paper was read by J. B. Rogers, superintendent of the Norton Iron Works, Ashland, Ky., on "The Use of Nut Coke in the Blast Furnace."

A very interesting discussion followed the reading of the paper, and much valuable information gleaned from the experiences of other operators with nut coke. It developed that some furnaces are now using coke that passes over a ¾-inch screen. One operator reported that he did not get as much breeze as from regular furnace coke, and did not make as much flue dust. The practice of putting coke breeze into furnaces will always give trouble, according to the experiences of several operators, while it was the opinion of coke operators present that small-sized coke must be free from breeze to be used efficiently. In addition to the results secured from the use of nut coke in the company's blast furnace, Mr. Rogers stated that nut coke was also successfully used in the cupola of their foundry making small castings.

A report of tests made on burning properties of coke was made by Mr. Tillinghast, and he will, in conjunction with the committee on standards, continue his experiments in this connection.

H. E. Bourne, of Oglebay, Norton & Co., Cleveland, brought up the question of the serious shortage of cars, stating that in his opinion the Interstate Commerce Commission should revert to the 1918 plan of car distribution, at the lake ore docks. It was the sense of the meeting that cars should be distributed on the basis of furnace requirements, instead of boat capacity, as is being done, with the result that some interests are now getting more than their fair allotment, and a telegram was dispatched to the director of service of the commission urging that a more equitable distribution of cars be made.

Design and Use of Water Cooled Floors

Discussion Showing the General Construction and Design of These Floors as Well as Their Intrinsic Value to Sheet and Tin Mills From Both a Labor and Production Standpoint.

By W. H. MELANEY.

ONE OF the greatest innovations in sheet and tin mill construction that has occurred in over 50 years, was the adoption of water cooled floors. In the old days no thought was given to any feature in the construction of these types of mills that did not show on its face, a saving in cost of construction, a material saving of time of production, or a higher grade product at the same or with a slight increase in cost. These were the points that stood for the "open sessame" to the sheet and tin trade, as competition was keen and the mill that could show the lowest production cost offered the best inducement to the trade.

But when the war with Germany was declared, different features entered the field. The prices of sheet and tin jumped skyward, and sufficient production was hard to get, due to the scarcity of labor and the excessive demand for steel. Then means that would insure greater production either by increased capacity or with such capacity as then existed, became a matter for serious consideration. And here is where water cooled floors came to the front.

The labor situation in sheet and tin mills is today most serious and it behooves the officials of all plants to do everything possible for the personal comfort of their employes. It is no longer a proposition of speeding up production through the laboring man but rather a question of planning by the official himself. Mr. Melaney, in his article on "Water Cooled Floors," gets right at the bottom of this very question. Perhaps he has solved a problem for you.

Prejudice Against New Methods.

It is a fact worthy of note that the greatest obstacle to be overcome in the introduction of any radical change in the operation of a rolling mill, is the prejudice shown by the workmen themselves, against any change in methods that they have not been accustomed to. So when water cooled floors were introduced to the trade, this same obstacle was encountered, notwithstanding the fact that these floors meant much greater comfort for these same men. Many objections were cited against water cooled floors, until one firm ignored this prejudice and equipped every mill in their plant with these standings.

Fallacy of Reasoning.

After a few weeks of operation, the utter fallacy of these objections were proven, and the workmen themselves became a unit in praising their virtues. Today the more modern plants in these lines are all installing water cooled floors, not as a luxury, but as a money saving device, to insure greater production, and no sheet or tin mill worker who has worked on these floors can be found who does not readily prefer this type of standing to any other.

Many laws have been passed by the state to guard the health and safety of employes, yet here is a condition where men are working eight hours continuously, in sheet and tins mills, on iron floors so hot that water dropped on it is immediately converted into steam, and heavy wooden soled shoes must be worn to prevent their feet from being par-boiled in their own sweat. The volume of hot air arising from these hot floors keep the man drenched in perspiration until their trousers hang around their legs like wet rags Just imagine this condition on a hot day in July or August and then decide for yourself what you think a man's efficiency will be, under such circumstances.

It is true, of course, that some attempt has been made to modify this condition by installing some method of blowing cold air on the men to keep the upper portion of their bodies down to a bearable temperature, but until water cooled floors were introduced nothing had been done to alleviate the burning temperature to which their feet were continually exposed. This condition was accepted as a matter of course because in the past, a practical method had not been devised to overcome it.

Genius at Work.

As is so often the case, the one to invent and put into service the first practical water cooled floor, was not a man who had been compelled to work upon the old-fashioned hot floors but one whose genius had helped to develop the modern methods of tin plate manufacture. J. B. Baird, deceased, who was a notable figure in the rolling mill world, was granted the original patent for water cooled floors, and today most of the water cooled standings in use in tin and sheet mills are of the original pattern designed by him and first installed at the Follansbee Brothers plant, Follansbee, W. Va.

Type of Floors.

The type of floor plate as finally decided upon by Mr. Baird, as representing the best in water cooled floor construction, was not simply a means of fulfilling his desire to produce a cool floor, but every detail of its construction was given careful consideration and much study, to determine its special fitness, both in effectiveness and practical design. This was done in order that no features that might later cause trouble would be incorporated in its makeup, and so successful was his reasoning that no changes have been found necessary after more than five years practical use.

Best Material for Construction.

One of the first features to be considered was its lasting qualities and its resistance to corrosion. This resulted in his rejection of wrought steel construc-

tion, as it lacked rust resisting qualities. Steel castings were found to have the same fault. After due consideration, it was decided that the best material for the construction of the plates would be cast iron, as it was known to be the most rust resisting of the common metals. It would also permit of the plates being cast in one piece, without joints, except the simple connection necessary for continuous water circulation.

The rust resisting qualities of cast iron is a matter of note, as it is a composite metal, in which carbon in the form of graphite predominates and protects the iron particles from corrosion; it also contains a large percentage of silica or slag which lends its rust resisting qualities to protect the composite mass. It also has, in combination with its rust resisting qualities, the commercial feature of being inexpensive.

Form of Construction.

Careful thought indicated that a comparatively small unit or plate was desirable for the following reasons: First, because a small plate lent itself admirably to building around such obstructions as doubling shears or steam doublers, which must of necessity be located close to the rolls and furnaces, and second, as the water pressure of the main would be in each plate, a more rigid construction was necessary. It also produced a level standing which cannot warp or become so smooth as to be dangerous for the men to work on, but rather present the same kind of a surface as the old-time floor. All this resulted in the adoption of a plate two feet square containing four square feet of area as the standard unit. A simple practical means of connecting these units so that a continuous water circulation could be maintained was imperative and for that reason the push nipple system such as is used in steam radiators was adopted.

These plates were then connected in separate rows, the width of the standing, with a two-inch taper push nipple, each row of plates being cross connected to the next row by means of pipe connections at either end of standing. In this way the water enters at one end of a row, circulates the length of this row, passes over through the pipe connection at end of standing to next row, and keeps on circulating until it traverses every plate in the entire standing of that mill. It is now discharged into the bosh or returns to the mills as needed. In this way the water is not wasted after giving up its refrigerating effect to the floor. The small unit and push nipple in addition, permits the removal of a plate from any part of the standing without trouble if it should happen to be broken from any cause. As each standing is separately connected to the water main through a supply valve, its temperature can be controlled to suit the crew on that mill, and can be operated independent of any other standing.

Disadvantages of Old Type Floors.

The old type standing on sheet and tin mills consisted usually of cast iron plates about four feet square and approximately one inch thick, laid side by side. As the red hot sheets or packs are thrown onto the floor for matching or doubling (as previously stated), these plates become so hot that water thrown onto them is almost instantly converted into steam. The whole standing then acts as a hot air radiator, and a volume of superheated air arises therefrom and produces an almost unbearable temperature to those not accustomed to this condition. This is especially so in the summertime and even men thoroughly inured to such conditions are frequently compelled to quit work on some days, especially if the humidity of the air is high. Their shirt and trousers become soaked with perspiration until it runs into their shoes and the final result is that their feet become so tender they are in misery. The only previous attempt ever made to better this condition, was to blow air from a large rotary fan across the standing, in an almost futile attempt to displace the continuously radiated hot air.

Advantages of Water Cooled Floors.

But the water cooled floor gets at the very seat of this trouble, by not only preventing this volume of hot air, but actually forms a volume of cool air over the entire standing, with the result that the workmen do not sweat below the wasteline, their trousers remain dry and as their feet are kept so cool that they can wear, if they so desire, light soled comfortable shoes on these floors, where heavy wooden soled brogans had been a necessity on the old floors.

The perspiring from the waistline up is due simply to the glare of the hot packs in process of rolling. These floors are maintained by the water at a temperature that permits the bare hand to be held in contact with them at their hottest point. Even on Saturday, after the mill has been in continuous operation day and night for a week, the water as discharged from the standing into the bosh is only about blood heat.

This is made possible because the water from the main is circulated through the standing at such rate as its pressure will force it through a three-quarter inch discharge pipe, the supply pipe being enough larger to keep the pressure of the main in the floor. The water does not circulate from one standing to another but each standing has its individual supply and discharge source and its water supply can be used or discontinued at will.

Comfort of the Men an Asset.

The oldtime spirit of not paying any attention to the comfort of the men is fast becoming obsolete, and the most progressive manufacturers of today are giving this subject much attention. As a result they are many times agreeably surprised to find that, what was at first regarded only as a welfare movement, developed into one of greater production. Any workman who is compelled to do his work under temperature conditions that are almost unbearable will never return to his employer the full measure of efficiency that is expected of him, no matter how great his efforts may be, nor how little the energy required to perform his task.

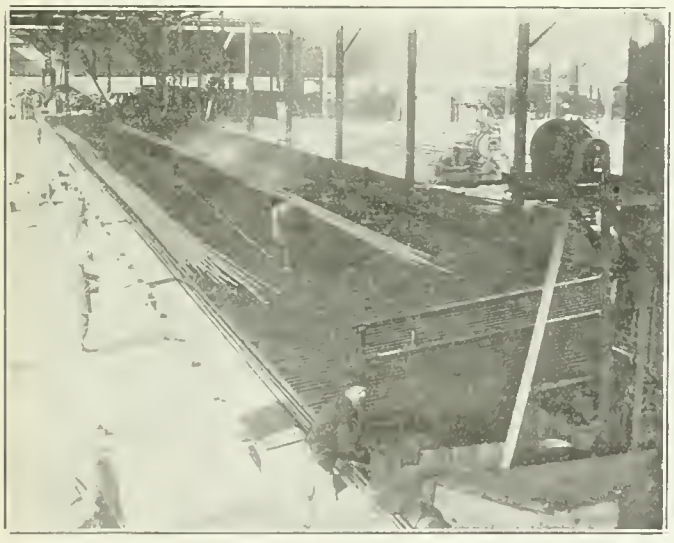
This is doubly true in a sheet or tin mill, as the work is not only hot, but laborious as well. It is a matter of record that greater tonnage is produced on water cooled floors, simply because there is no loss of time, due to the men knocking off because of the extreme heat.

Another feature that should not be overlooked in these strenuous times when good workmen are hard to get because of their scarcity, is that these men will naturally select the positions offering the most humane and comfortable conditions, and the progressive employer who keeps this end in view, will be rewarded by having the choice of the most skilled workmen that the market affords.

Columbia Steel Company's New Plant

A Description of the New Rolling Mills Constructed by the Columbia Steel Company at Pittsburg, California—Electrically Driven Merchant Mills for Production of Bars and Shapes.

THE Columbia Steel Company have increased their operations at Pittsburg, California, 50 miles northeast of San Francisco, to a large extent by constructing a modern rolling mill, the products of which consist of square deformed bars for reinforcing from ⅜ inch to 1¼ inch, plain square and round bars, from ½ inch to 1½ inch, and rivet rods ⅝ inch and larger. Previous to the construction of this department, this company operated the largest steel foundry west of the Rocky Mountains. The foundry was constructed in 1918, and originally consisted of a 20-ton basic open hearth furnace; a 10-ton and a 30-ton basic furnace were afterwards built. Its products were principally railroad and sugar mill casting; however, during the war it supplied the Pacific coast shipyards to a large extent. During all



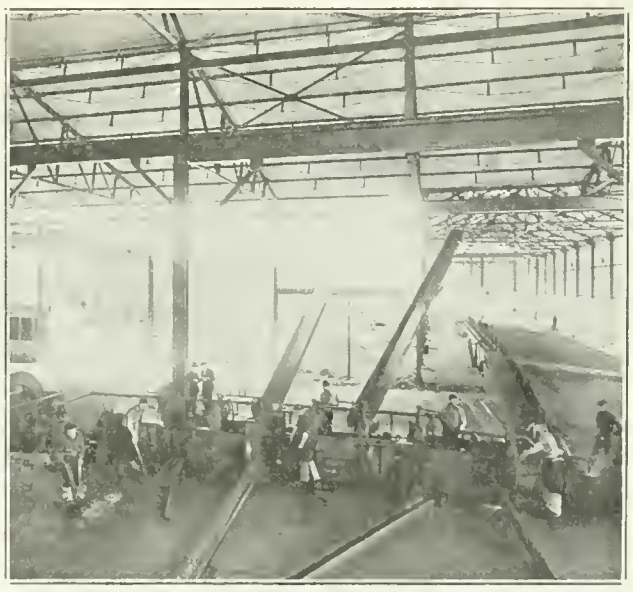
The 12-inch cooling beds showing the finishing shear in the foreground.

this time the tonnage gradually increased until now it averages about 7,000 tons of open-hearth steel a month.

The new additions consist of an 18-inch merchant mill, an 18-inch roughing mill and a 12-inch finishing mill. Later on an 8-inch mill is to be added. The open hearth department furnishes these mills with 8-inch bottom cast ingots. Construction was first started on these additions in August, 1919. However, they were not ready for operation until March 29, 1920. The construction has been considerably delayed by the coal, steel and railroad strikes of the past year.

Operation was first started on the 18-inch merchant bar mill which commenced breaking down 8x8 inch ingots into billets. These billets were to be finished into bars on a 12 inch Belgian mill.

The 18-inch merchant mill, which, as has been mentioned before, is used to break down ingots into billets, consists of four stands of rolls, three of which are three high, and one of which is two high. This mill is electrically driven by an 800 hp heavy duty slip ring type rolling mill motor, with a speed of 257 rpm and reduction gears three to one. The speed of the mill is 85 rpm. The mill is most modern and is equipped with out-board bearings and enclosed pinions. On each side of the mill there is a mechanically operated tilting table which handles the ingots. It is the intention to roll large rounds, squares and shapes directly from the ingot on this mill at a later date.



The 12-inch Belgian mill with the cooling bed in the background. Note the steel troughs used to keep large bars off the floor.

The 12-inch Belgian mill is a five-stand mill, four stands of which are three-high and one stand two-high. In connection with it, this mill has an independent single stand, three-high 18-inch roughing mill. Each of the mills are independently driven by two 450 hp motors with a speed of 350 rpm. The 18-inch roughing mill has a speed of 100 rpm with a reduction gear 4½ to 1. The flywheel of this mill is 12 feet in diameter and weighs 14 tons. The 12-inch mill has a speed of 185 rpm and a reduction gear of 2½ to 1. The flywheel is 10 feet in diameter and weighs 10 tons.

The cooling bed for the 12 inch mill is 20 feet wide and 200 feet long with top and bottom conveyors. The bars are delivered by bottom conveyors to finishing shears in the end of the storage building. Similar hot bed equipment will be supplied for the 18 inch merchant mill. All billets are delivered on electric

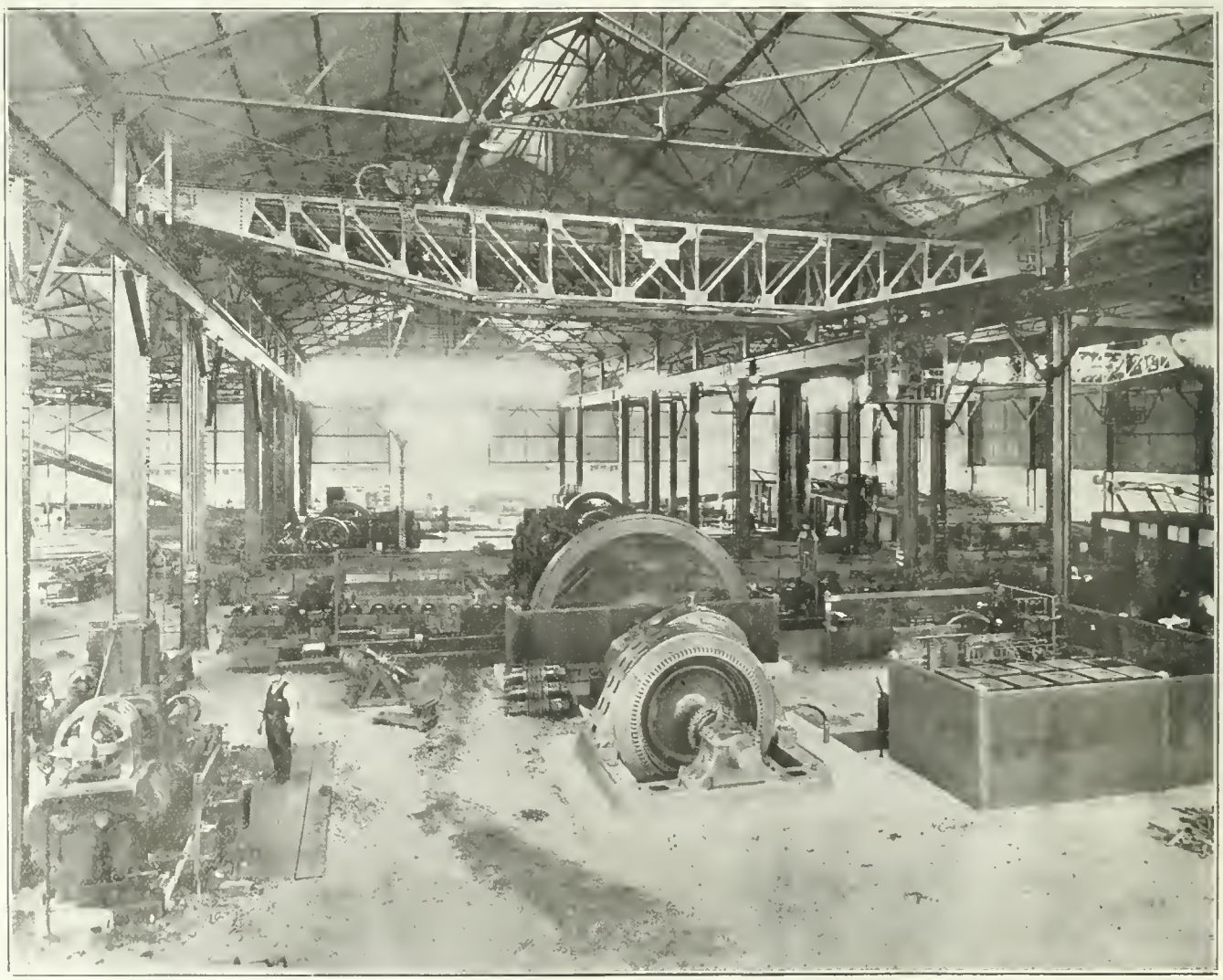
driven conveyors to and from the various mills.

The blooms for the 18-inch merchant mill are heated in an oil fired, pusher type continuous furnace 91 feet 0 inches long by 6 feet 6 inches wide. The capacity of this furnace being 100 eight-inch square blooms. The furnace for the 12-inch mill is practically the same with the exception that the dimensions are 45 feet long by 13 feet wide.

All the motors driving the mills are on alternating current, while those driving the motors for the tables and conveyors are direct. All electrical equipment in the plant was furnished by General Electric Company. The three mills are designed and built by the United Engineering & Foundry Co. The reduction gear sets were furnish by Falk Company. The Columbia Steel Company themselves designed and constructed the tables, conveyors and shears. In addition, they also built the ingot extractor which is operated by compressed air. This machine delivers the blooms from the furnace to the tilting table. The machine travels back and forth on a track and the table revolves on a car. This revolution is necessary as it is essential that all ingots be delivered into the blooming rolls small end first. This extractor does its work very quickly and efficiently.

There are a series of six modern buildings which go to make up the rolling mill department. These buildings constructed by structural steel are of the \ roof type and are covered with galvanized corrugated iron. They are constructed with high roofs which make them very light and airy. The billet building is 60x260 feet and has two 5-ton overhead traveling cranes included in its equipment. The mill building is 60x240 feet and has a 10-ton crane. This building has a lean-to 40x200 feet. The hot-bed buildings are all 40x200 feet and the shipping and storage buildings 80x200 feet. The cranes included in these buildings were furnished by the Cyclops Iron Works, San Francisco.

A feature of this plant which cannot be overlooked is the precaution taken to insure safety. All gearing is solidly inclosed and motors, transformers and flywheels are surrounded by heavy wire screening. Steps and platforms are built to permit ready passage from any side of the mill to the other and a further feature is that the layout permits the traveling of steel in practically a straight line from the ingot to the finished product. This is no small factor in securing economical productions. There was no interruption in the early period of operation as is commonly the case, the first month showing the aver-



A general view of the mills showing the 18-inch merchant mill in the foreground.

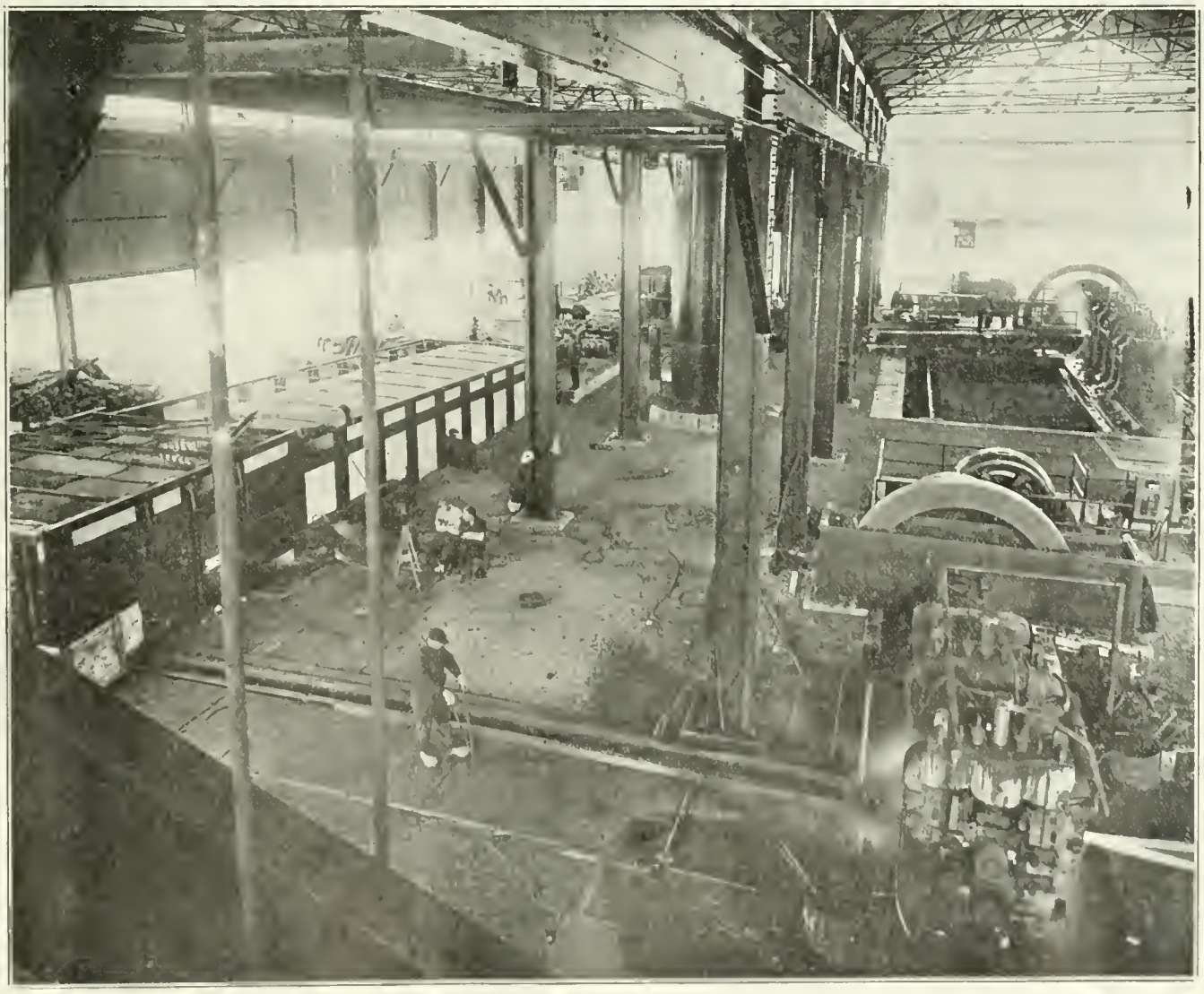
age output of about one-third tons in 8 hours.

All the finished products for exporting is shipped direct by lighters from the company's docks and delivered alongside of the steamers in San Francisco Bay. All domestic shipments are handled by the two transcontinental railroads, the Sante Fe and the Southern Pacific which pass through Pittsburg and offer facilities for rapid and efficient transportation.

The success of the Columbia Steel Company to date can largely be attributed to officials of the company. The officers are W. E. Creed, president; and J. D. Grant, vice president and Russell Pierce, secretary and treasurer. T. J. Patterson has been made general superintendent of the new steel plant and B. Whitehead is in charge of the foundry. Mr. Patterson has appointed as his assistants N. A. Becker as superintendent of the rolling mills, Frank Maestri, open hearth superintendent, and C. A. Baker as foreman of the machine shop, all of whom are practical mill operating officials.

The design of the plant was principally in the hands of George E. Sibbert, the chief engineer of the company. The sales department, with John D. Fanstemacher in charge is rapidly developing and offices will soon be established in the principal cities of the West.

The completion of the plant of the Columbia Steel Company will add much to the progressive Pittsburg district in California, as it will give it a new and most modern industry. In fact, the Western states have always had to depend, to a large extent, upon the eastern part of the country for their steel supplies. However, the development of steel plants and a number of foundries before and during the war period have done away with this condition to a large extent. As stated before, Pittsburg had the largest foundry in the West and it is predicted by many, that it will rapidly be developed into the steel center of the district. This is an ideal location for handling export shipments to the far eastern countries, particularly China and Japan who are constant buyers of steel; and also its close proximity to the large cities of the Pacific coast gives every reason to believe that this will be the case. At that time it may reach such a point as to be a rival of its famous predecessor, Pittsburgh, Pa.



A view showing the heating furnace and the conveyor which delivers the billet directly into the 18-inch roughing mill.

Design of Experimental Rolling Mills

Description of the Details of the Design of the Experimental Mill of the Bureau of Rolling Mill Research—General Features of the Different Types of Mills When They Are Assembled.

By W. B. SKINKLE,
Director, Bureau of Rolling Mill Research.

PART II.

THE first installment of this paper covered a description of the power generating equipment and the gear reductions between motor and mill. The present installment will be devoted to the general features and different types of mill into which the equipment may be assembled.

Fig. 5 shows a diagramatic plan of the mill with reference letters showing the points where the several sections which follow are taken.

Fig. 6 is a section taken on lines A-A Fig. 5, and shows a side elevation of the bearing frame which carries the driving shafts and the extension for the motor armature shaft. These frames rest on an extension of the shoe plates and are rigidly held in place by lugs and bolts. The bearings for the jack shaft are cast to the side of these frames.

Fig. 7 is a section taken on lines B-B of Fig. 5, and shows a side elevation of the bearing frames for the outboard bearings of the continuous mill drive. These frames are very similar in construction to the ones just described except for the extensions carrying the bearings for the idle gears.

The middle frame is held in place on the shoe plates by lugs and bolts. The lugs at the shoe plates are omitted on the two outer frames to allow these castings to be drawn firmly together by the connecting bolts.

The outlines of the spur gears are shown in light lines. The idle gear bearings are adjustable in both a horizontal and vertical direction and are bolted and keyed in place. This allows changes in the reductions between passes to be made by changing only one gear, as the idle may be brought into mesh by these horizontal and vertical adjustments. A 25 per cent reduction is shown between passes.

Fig. 8 is section taken on lines C-C of Fig. 5, and shows a side elevation of the pinion housings. These housings have extensions for carrying the bearings of the idle gears, which are exact duplicates of those on the bearing frames.

If the mill is to be used as a straight, hand-fed, three-high bar mill, the first and third pinion housings will not be used. To disconnect these housings the bolts "A" are loosened and the fillers "B" removed, allowing the idle gears to drop down out of mesh with the driving gears.

All bearings throughout the drive will be so designed that babbitt, bronze, roller or ball bearings may be used in them.

This will allow the securing of comparative data on power requirements for all classes of bearing when the mill is working under the same operating conditions as regards product, speed, temperatures and grades of steel.

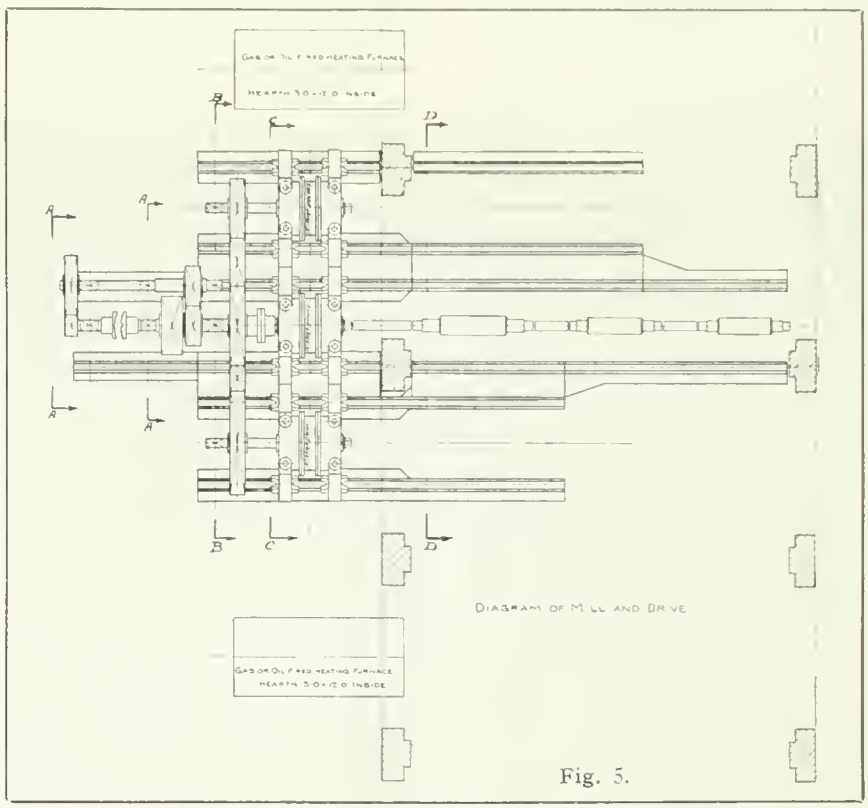


Fig. 5.

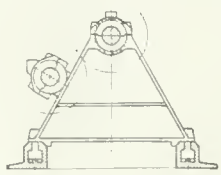


Fig. 6.

Fig. 9 is a plan view of the mill and drive when the housings are assembled for work as a hand-fed, three-high bar mill.

The first housing (nearest the pinion) is rated as an 18 inch stand but rolls as large as 24 inches in diameter may be assembled, while the filling for the three-high bar mills may be used on diameters down to 16 inches.

The other two stands are duplicates and while rated as 14 inch stands they will take rolls between 10 and 16 inches diameter.

The maximum length of roll bodies for all three stands is 13 feet. As shown, the first stand has a 5-foot long body and the other two stands each have 4-foot long bodies. This 13 feet of roll body in the three 3-high stands should allow passes enough to roll a large variety of sections.

Fig. 10 shows a cross section through the mill when this assembly is used. Close examination of

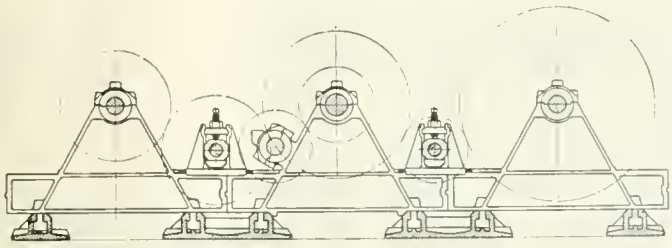


Fig. 7.

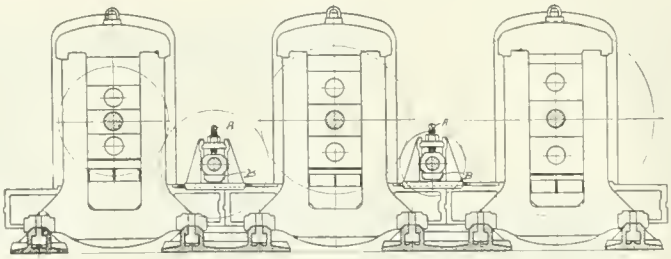


Fig. 8.

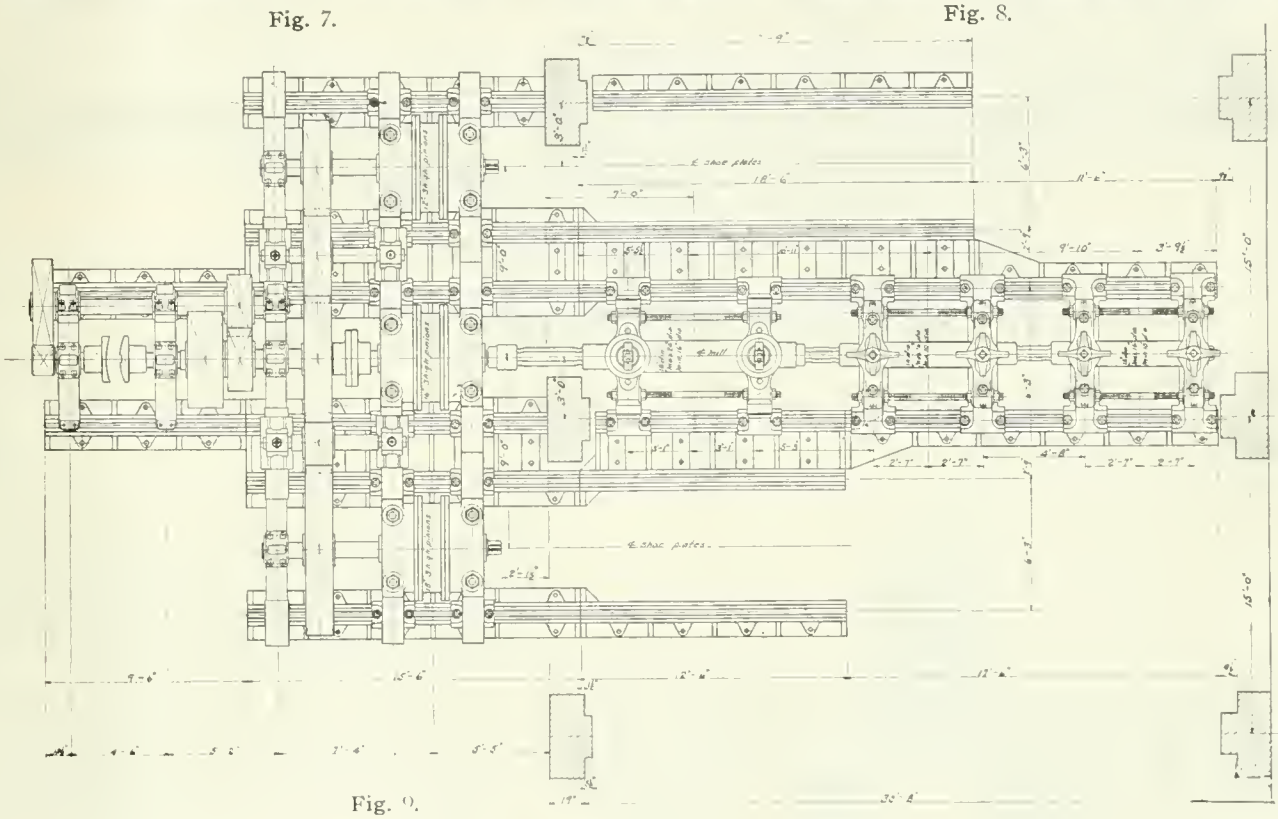


Fig. 9.

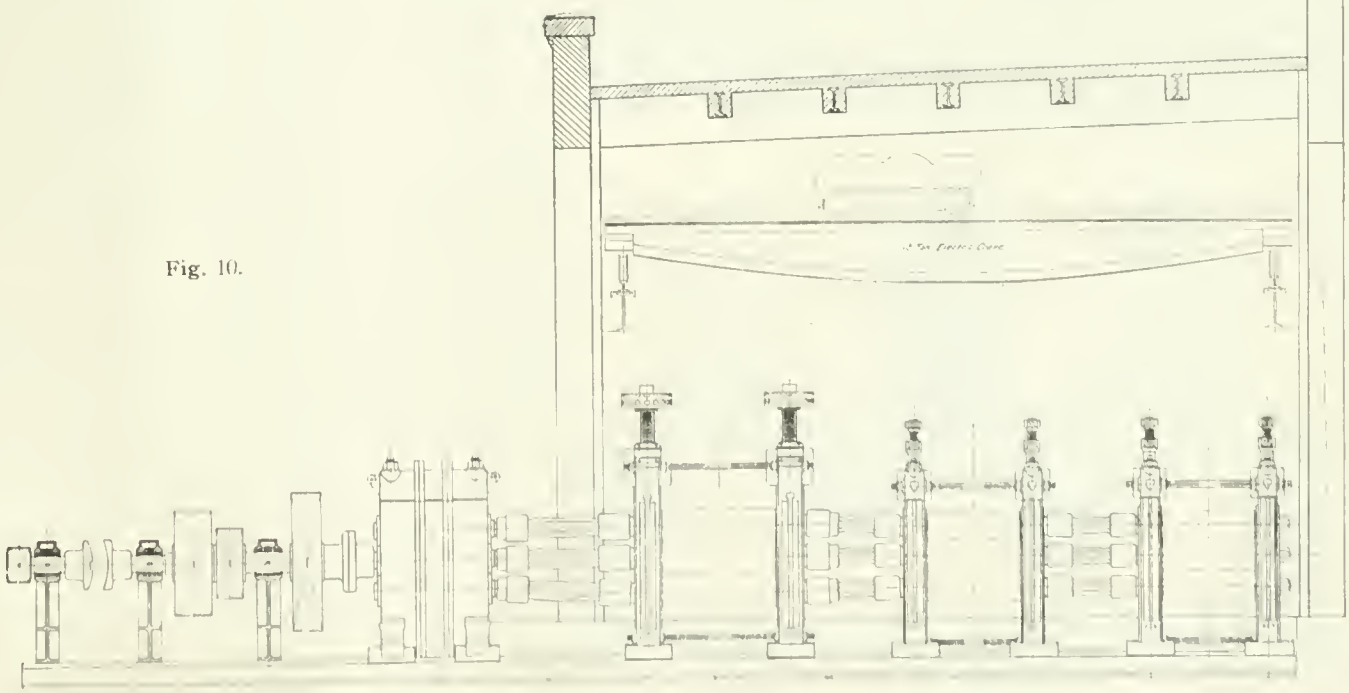


Fig. 10.

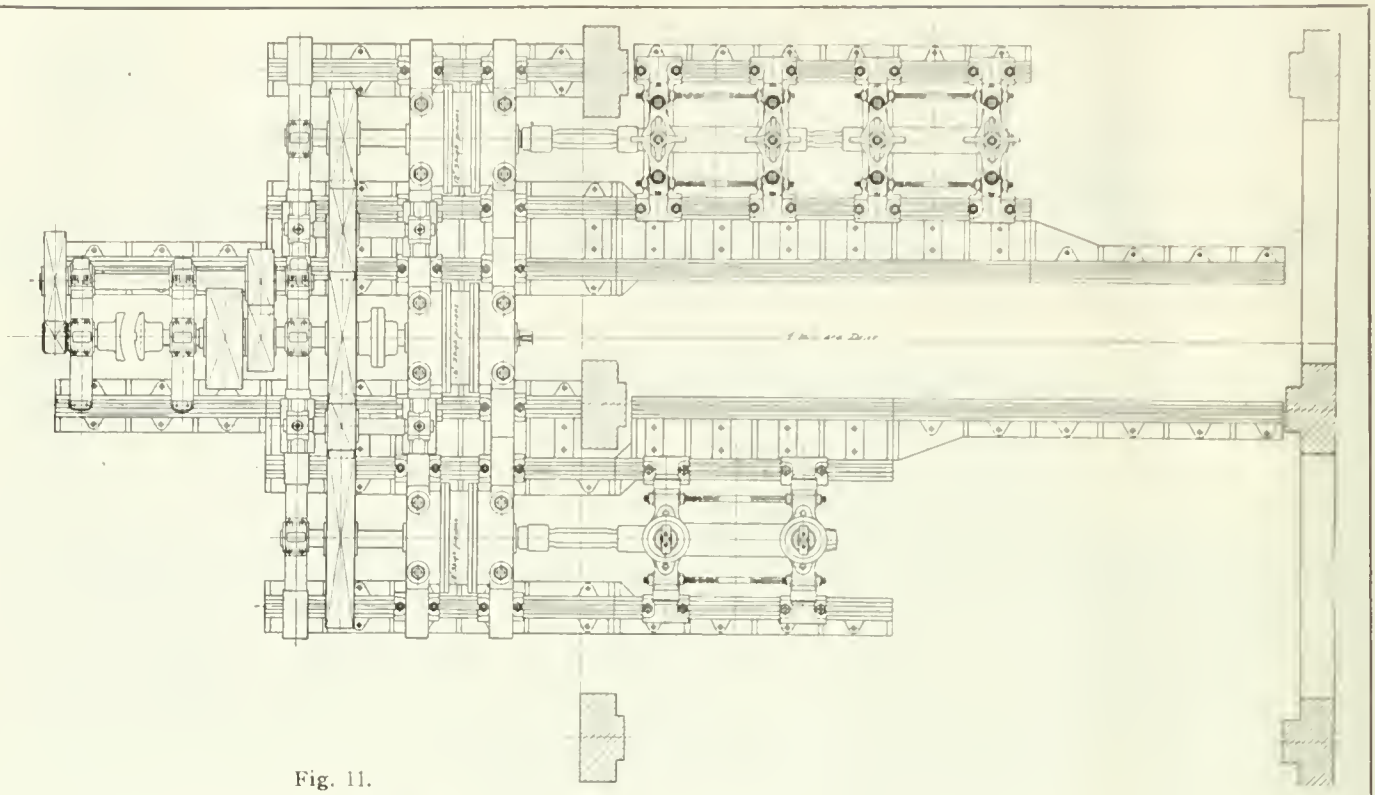


Fig. 11.

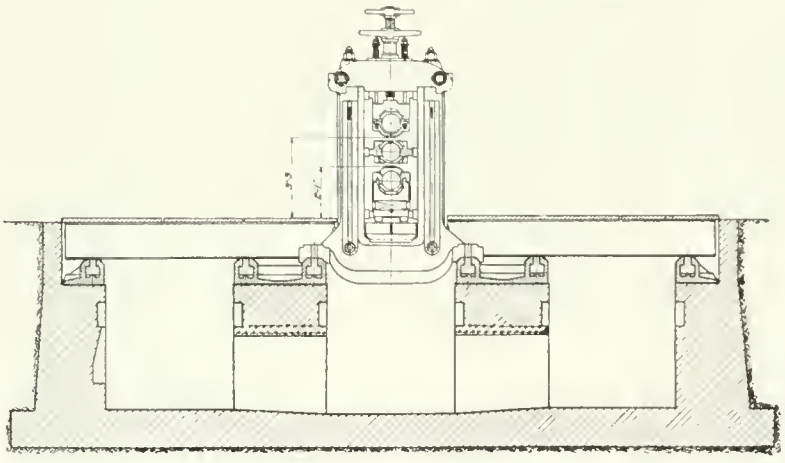


Fig. 12.

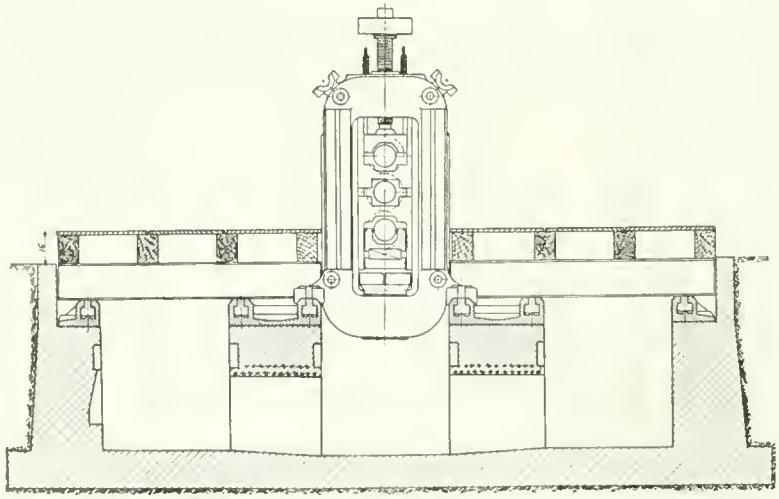


Fig. 13.

the drawings will show a slight "lead" in the spindles between the 16 inch pinions and the 18 inch rolls of the first stand, and another lead between this 18 inch stand and the 16 inch rolls in the second stand.

The pods on the rolls and spindles are made of the vibrating type to permit as much of this lead as possible without interfering with the operation of the mill. In extreme cases, say for example, an 18 inch roughing stand is to be run with two stands of 10 inch finishing mill, this lead of the spindles between the stands would be too great, and it would be necessary to assemble the mill as shown in Fig. 11.

In this assembly the 18 inch rolls are connected to the first stand of 18 inch pinions and the 10 inch rolls are connected to the third stand of 12 inch pinions. There is room between stands to roll a 12 foot long bar, which should be long enough for experimental work. Excessive lead in the spindles, between stands, is avoided in this manner.

Fig. 12 is a side elevation taken on line D-D of Fig. 5, and shows the small roll housing when used as a three-high bar mill assembled on the middle line of shoe plates. The shoe plates are dropped below the floor just far enough to allow an 18 inch I beam to be placed on them and bring their tops to floor level. Cast iron floor plates are then arranged on top of these I beams in the manner shown.

Fig. 13 shows a similar view of the large closed top housing when assembled as an 18 inch three-high bar mill.

When rolls of this size are used the sections rolled may get fairly heavy and be difficult to lift high enough to return through the top rolls. In order to cut down this lift as much as possible a number of 10x16 inch timbers are laid

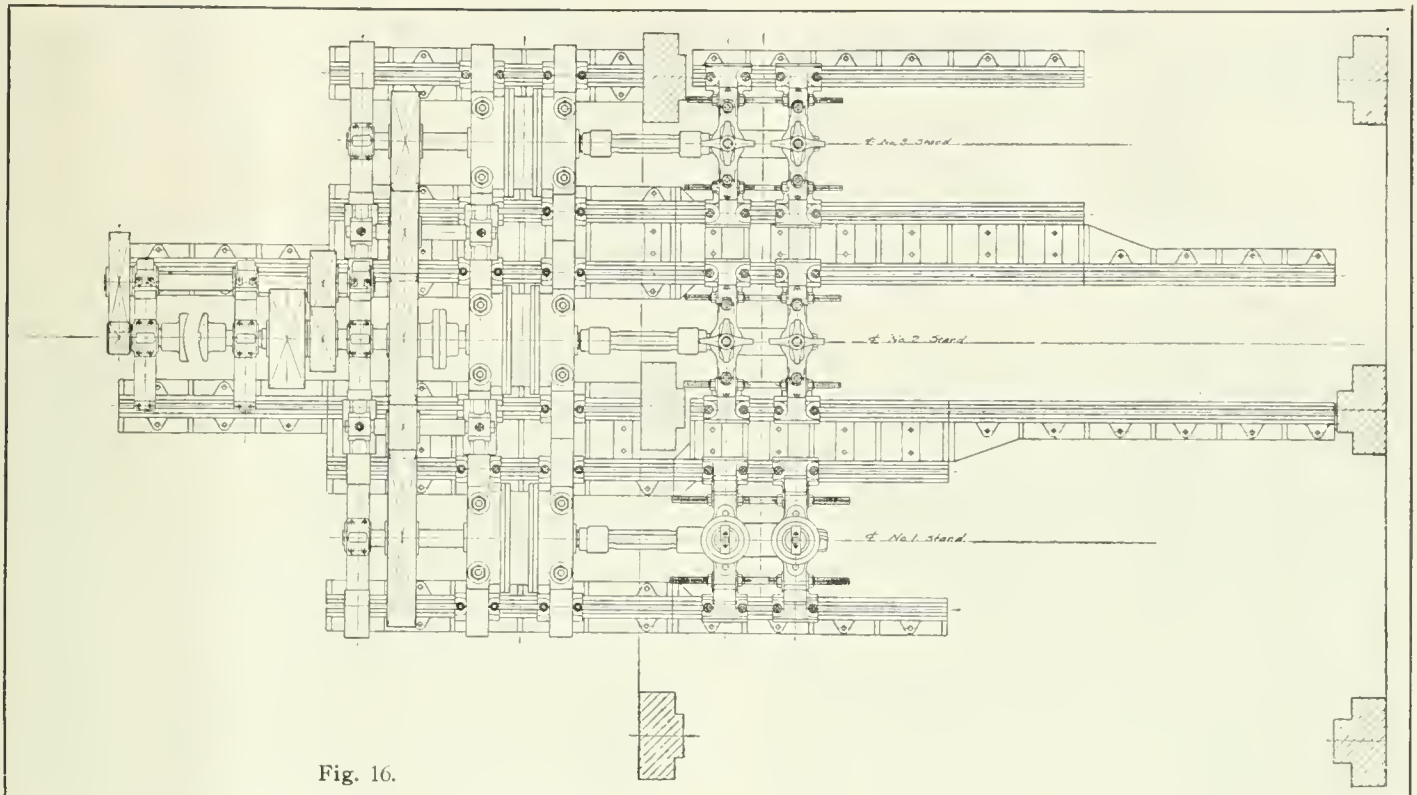


Fig. 16.

across the 18 inch I beams and the floor plates arranged as shown. This brings the floor level as high as the guides for the bottom rolls will permit, and cuts the lift necessary to return the billet through the top rolls, to a reasonable amount.

In case the bloom to be rolled is too heavy to be handled by men, the entire floor system may be removed and two small lifting tables of light design substituted as shown in Fig. 14.

In this construction the outer lines of shoe plates are used as foundations for supporting the small structural girders that carry the fulcrum bearings and synchronizing mechanism. The lifting cylinders for the tables have feet cast on the bottom heads, which lift the inner shoe plates and are bolted to them. Should this housing be assembled as a two-high blooming or plate mill of the reversing type, the fulcrum bearings and synchronizing mechanism may be replaced by small beams of the proper height laid across the girders. The tables would then become the ordinary type of stationary front and back tables.

Fig. 15 is a section taken on lines D-D of Fig. 5, and shows a side elevation of the three stands when used as a continuous mill. The top rolls have been abandoned and only the two lower rolls kept in service.

The author believes that three stands are sufficient to prove out the flow of metal in continuous mills. Take for example, the middle stand. It has three functions to perform. First, it must take care of all the metal delivered to it by the first stand; second, it must change the shape of the metal, and third, it must deliver this metal to the third stand at exactly the proper rate of speed. Fig. 16 is a plan view of the continuous mill and drive.

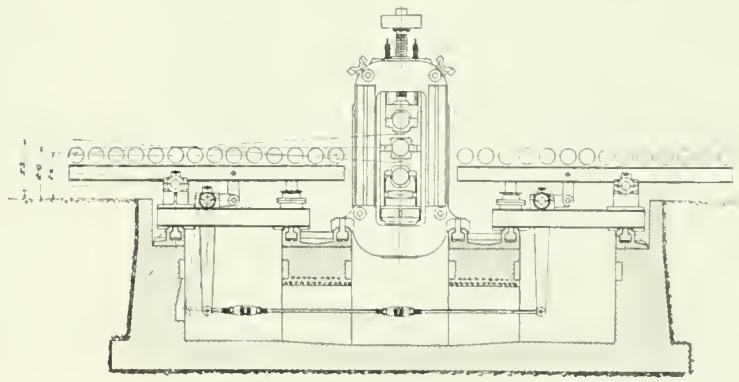


Fig. 14.

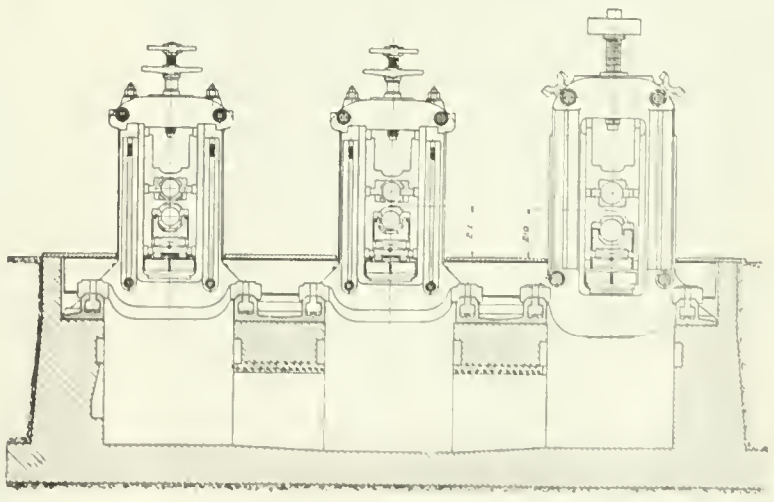


Fig. 15.

Modern Methods of Manufacturing Pig Iron

A General Description of the Process of Making Pig Iron in a Modern Blast Furnace, Showing How the Blast Originates, Enters the Furnace, and How It Is Discharged.

By LAWRENCE L. ARNOLD,
General Superintendent Wickwire Plant.

THE manufacture of iron is conducted in the blast furnace and is usually referred to as the smelting of iron ore.

The principal materials used are iron ore, coke and limestone. Iron ore may be described as an impure oxide of iron or iron rust mixed with more or less earthy matter called gangue. The gangue is usually composed of silica and alumina with from a trace to substantial quantities, of lime and magnesia with traces of sulphur and varying amounts of phosphorus, rarely exceeding ½ of 1 per cent, in ores used in lake furnaces. Iron ores are classified as hematities, which are so named because of the red streak made when a piece of ore is rubbed on an unglazed porcelain surface. The oxide of iron in hematities has two atoms of iron combined with three atoms of oxygen. Brown ores or limonites are the same in composition as hematities, except that they contain water of combination that is only driven off well at about 212 degrees F. These ores give a brown to yellow streak when rubbed on unglazed porcelain. Magnetites are the magnetic variety, as lode-stone, in which the percentage of oxygen is less than in hematite. The carbonate ores are carbonates of iron and are not used in the lake furnaces.

Limestone, as used in the blast furnace, is a more or less pure carbonate of lime such as is used in kiln burning for quick-lime. It should be as low in silica as possible. Often some magnesia displaces some of the lime in the stone and in certain quantities is desirable in the blast furnaces. Dolomitic limestone contains several percent of magnesia and when the magnesia is in the proportion of one molecule of magnesia to one of calcium oxide (lime) the stone is a true dolomite.

Coke for the blast furnace is a specially made fuel produced from selected coals and coked either in beehive ovens or by-product retort ovens. The qualities required are toughness, free burning, low ash and sulphur contents with great uniformity in size, structure and analysis. The carbon in the coke varies from 85 per cent to 90 per cent and even higher and is the fuel and also the principal chemical reagent (as we will see later) upon which the life and success of the furnace depend.

The modern blast furnace is of the shaft type and varies from 80 to 100 feet in height. All horizontal cross sections of the interior of the furnace are circular while the diameters vary at different heights. Starting with the hearth or bottom of the furnace we find a cylindrical well built of fire brick and surrounded with a heavy steel-plate jacket. Between the jacket and brick lining are vertical cooling plates which cool and protect the brick work. Near the bottom of the hearth is an opening through the jacket and brick work at a predetermined point, called the tapping hole. This simple location determines the front of the furnace. Higher up from the bottom is a second opening called the cinder-notch through which slag is run from the hearth when desired.

The hearth joins the base of the bosh or is surmounted by the bosh. The bosh is built of firebrick and is in the shape of an inverted frustrum of a cone. The inside diameter where it joins the hearth is the same as the hearth diameter. The bosh of a modern furnace is usually about 12 feet high while the diameter increases with the height and at the top (called the bosh angle) we reach the point of greatest diameter in the furnace. Surrounding the bosh are heavy steel bands and between these bands, in horizontal rows, are inserted flat segmental hollow cast-bronze plates, known as bosh-plates, and through which water circulates in order to cool and protect the brick work, which is here exposed to the greatest heat and fluxing action to be found in the furnace.

The top of the bosh is joined by the stack which is a frustrum of a cone, but with the smaller diameter at the top. The height of the stack is several times that of the bosh. This stack is also made of firebrick or rather is a firebrick lining in the steel shell or jacket of the furnace. The stack-jacket is of heavy boiler plate construction and rests upon the mantle ring, which is in turn supported by the columns of the furnace. A large ring of cast steel is riveted to the top of the stack jacket and upon this rests the hoppers through which the materials are charged into the furnace. The brick lining of the stack extends up to this ring and back of the conical hopper which projects down within the hopper ring.

The furnace top is closed with a large steel bell or cone (usually about 12 feet in diameter and weighing five to six tons) which is suspended on a heavy bell rod. This bell can be raised and lowered and thereby opens or closes the hopper with a cup and cone effect. Above the main hopper is the small or receiving hopper which in turn is closed with a small bell. These bells are operated alternately and in this way make a vertical gas lock through which the stock charges may descend into the furnace without any gas escaping. Just below the hopper, through the shell of the furnace and lining are two openings into two large gas mains or down-takes called down-comers. The function of these gas mains is to carry the waste gases down to stoves and boilers in order to preheat the air with which the furnace is blown and to fire the boilers.

As the furnace must be blown with a large volume of superheated air, some provision must be made to compress, preheat and conduct this air to the tuyeres or points of entry. A 500-ton furnace requires 40,000 to 45,000 cubic feet of air per minute under a pressure of from 14 to 20 pounds, which requires blowing engines of from 4,500 to 5,000 hp. A furnace receiv-

Taken from "Wick-Tack," published by the Wickwire Spencer Steel Company, Buffalo, N. Y.

ing 45,000 cubic feet of air per minute will consume about 1,700 tons of air in 24 hours or 3.3 tons of air per ton of iron produced.

Massive boilers and blowing engines are provided to compress the air which is conducted from the blowing engines to the hot-blast stoves where it is heated to a high temperature. From the stoves it is conducted through a large firebrick lined main to a large main that circles the furnace at about the mantle level. This large main circling the furnace is known as the bustle pipe. From the bustle pipe are 10 to 12 connections, equal to the number of tuyeres entering the furnace. These connections are called tuyere-stocks, down through which the blast descends to the blow-pipes which enter the tuyeres. The hot blast stoves are usually four in number and are large steel-plate cylinders from 20 to 22 feet in diameter and from 85 to 100 feet in height closed at the top with steel-plate domes. These stoves are lined with fire-brick, contain a combustion space or well in which to burn the waste gas from the furnace, and massive checker work of brick to absorb the heat produced. The stoves are equipped with hot-blast valves, cold-blast valves and blow-off valves and an air main for the relatively cold air from the engines and also a hot main leading to the furnace. The usual practice is to blow through one stove with proper setting while three stoves are receiving gas, heating up. Stoves are changed every hour, that is, the cold air is diverted through a newly heated stove every hour.

We have briefly outlined how the blast originates and enters the furnace. All of the solid materials are charged into the top of the furnace where they are carried in skip-cars having been previously assembled and weighed in the charging cars in the stock house. In normal operation the blast is constantly entering the tuyeres and the furnace is kept full to the top with the regular materials. As fast as melting takes place in the hearth and bosh the stock descends and more is charged at the top. We now have a flow of gases up through the furnace from the tuyeres up through the solid stock and out of the top through the down-takes. Against this flow of gas is a solid column of ore, coke and limestone slowly descending within the furnace.

The greatest heat is generated at the tuyeres where the blast enters and the heated gases, in going up past the descending stock, impart their heat to the solids of the charge. Thus we have cold stock entering the top of the furnace and cooling the gases at this point, but all the way down these solids are absorbing more heat from the constantly hotter gas, so that finally the highest temperatures are reached by the charge in the bosh of the furnace. When the blast enters the furnace, the oxygen of the air is at once burned to carbon-monoxide which is the product of incomplete combustion of carbon. Had this same coke been burned in a shallow fire with an excess of oxygen, the result would be carbon-dioxide. The first gas (carbon-monoxide) contains one atom of oxygen for each atom of carbon. The second gas (carbon-dioxide) contains two atoms of oxygen for one of carbon. The first wants more oxygen to complete its combustion. It will burn in air to carbon-dioxide. We often see it leaking out of the brick work of the bosh and burning outside of the furnace. It is this gas (carbon-monoxide), hungry for oxygen, that goes up through the furnace and takes oxygen from the ore (iron oxide, or iron rust), and leaves the ore as a metallic sponge.

As the charge begins to descend through the furnace, the ore gradually becomes heated and the gases begin to take the oxygen from the ore; at the same time the limestone begins to give up its carbonic acid gas, just as it would do in a lime-kiln. Finally, when the charge reaches the top of the bosh, the ore has lost most of its oxygen to the gases and we have a metallic iron sponge containing still some traces of oxide and mixed with the gangue of the ore. The ash of the coke, at this point, begins to separate, then, finally the fluxing action of the burned lime begins with the ash of the coke and the gangue of the ore—slag is formed, melts and runs down through the coke, that fills the bosh. At the same time, solid carbon and high heat (carbon always hungry for oxygen, but none to get here except the small amount left in the iron sponge) take the last oxygen from the iron, the iron becomes carburized, making it fusible and it begins to melt and filters down through the coke in the bosh.

The iron and slag collect in the hearth and the slag, being the lighter, floats upon the iron. Iron is tapped from the furnace at regular intervals, as is also the slag.

The reactions in a blast furnace between the charge and the gases are many and only the principal ones have been touched upon. The proportion of flux to the charge has a profound influence upon the success of the operation.

The control of the furnace consists in maintaining the right hearth temperature, and the proper slag analysis, which, in turn, largely determine the kind of iron produced. Furnace temperature is controlled by varying the proportion of coke charged with the ore, by changing the blast temperature or volume. The melting point of the slag largely governs the hearth temperature: For example, it is impossible to heat a pan of water containing a piece of ice, much above freezing point, as long as any ice remains.

Iron, as it runs from the furnace, is at about 2,600 degrees F., slag at 2,700 degrees F., while the temperature in front of a tuyere is over 2,900 degrees F.

The composition of the slag is changed to meet requirements by mixing ores of different gangue analysis and by varying the quantity of limestone charged. Pure iron is never made in the blast furnace, as furnace metal always contains several per cent of carbon and other elements in smaller amounts. Some of the ordinary grades vary as follows: Carbon from 3½ to 4¾ per cent, manganese from a trace up to 2½ per cent, silicon from ½ to 3½ per cent, and sulphur from a trace up to five hundredths of 1 per cent, in good iron.

Successful operation of the furnace depends upon many things, notably proper materials, which must be uniform, above all things, and most important of all, the furnaceman must be sustained by an active force of loyal, intelligent men.

In conclusion, it may be of interest to note that a furnace making 500 tons of iron per day, will consume 1,000 tons of ore, 500 tons of coke, 260 tons of limestone and about 1,700 tons of air. The cooling water required to prevent the lower part of the furnace from burning out or the iron from breaking through, amounts to 10,000 gallons of water per ton of iron produced.

Heating Furnaces and Annealing Furnaces

Factors Affecting the Strength and Durability of the Furnace —Strength of Iron and Steel at Furnace Temperature— Strength of Fire Brick—Forces in Roofs and Arches.

By W. TRINKS.

PART XIX.

FACTORIES with furnaces usually carry bricklayers on their payrolls, because there seems to be no end to the repairing which is required by furnaces. Arches fall in, doors lose their bricks,

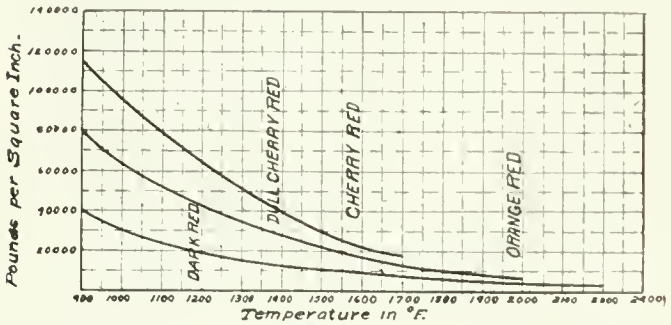


Fig. 127.

hearths need attention, bridgewalls are burnt off, regenerators are slagged up, and so on in seemingly endless continuation.

The question naturally arises in the mind of every furnace owner: Is this continued repairing a necessity, and what forces are acting to destroy furnaces so quickly?

The answer is that a large part of the repairing is caused by improper furnace design and by poor materials, while another large share of the repairs is caused by careless operation. Just to what extent repairs can be avoided will become clear from a study of the forces which act upon furnaces and the materials from which the furnace is built up.

The impressed forces are themselves, as a rule, quite small and would not harm a cold furnace; the destroying agency must, therefore, be something else. As a matter of fact, it is found in the various effects of high temperature. The latter causes expansion, and tremendously great forces if the expansion is resisted. Cooling causes contraction, and repeated changes of temperature cause relative motion between the very hot parts and those which are not heated so much. Walls which cannot be laterally supported gradually lean over under this motion and finally collapse.

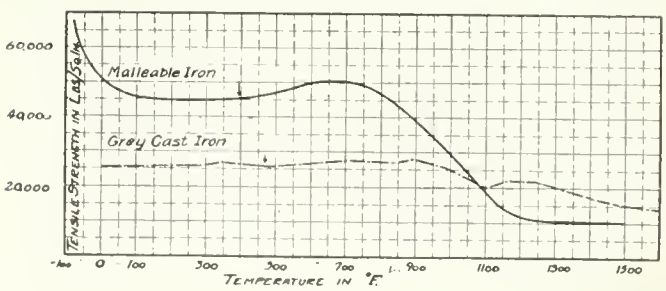


Fig. 128.

The worst effect of high temperature is the loss of strength of the materials from which the furnace is built. Iron and steel loose their strength, are oxydized, burn or melt away. The so-called refractory materials, fireclay, silica, alumina, carborundum, and others, stand higher temperatures, but their resistance is likewise overcome at certain temperatures. They are softened, yield, or spall off, either of which result in the destruction of certain parts of the furnace.

Another important agency in the destruction of furnaces is slag. Oxides of the materials that are being heated, or ash carried over from the fire, combine with the refractory material forming a salt or flux which melts at a temperature below that at which the pure refractory softens. A large number of furnaces is destroyed by this action.

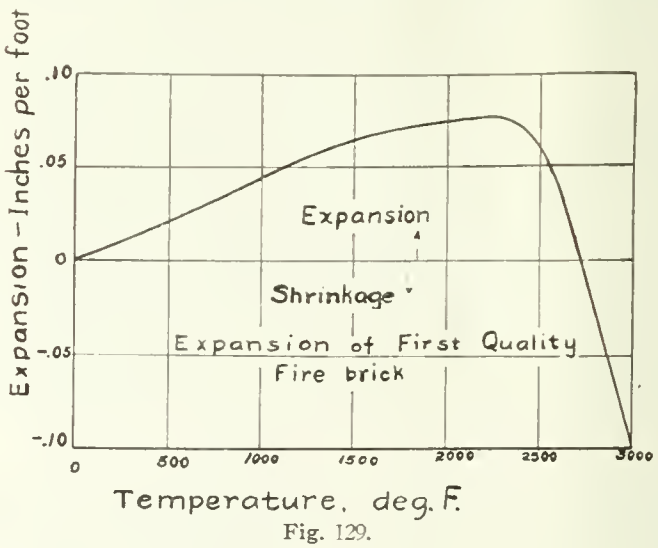


Fig. 129.

In order to obtain numerical data, we must study the effects of temperature upon furnace materials.

Fig. 127 shows the tensile strength of steel plotted against temperature. Steel is used as a structural member in the interior of high temperature furnaces, not only because its strength wanes, but because it oxydizes and burns away too rapidly. It is used for hearth bars and for hearth plates up to 1,600 degrees F., and even at that temperature steel oxydizes rapidly, if the furnace is operated with a flame that contains free oxygen. For the same reason steel must be protected from flames issuing from doors, openings, holes or cracks.

Fig. 128 is a graphical representation of the tensile strength of ordinary cast iron and of malleable cast iron at various temperatures. Although grey cast iron is a brittle and weak material, it is much used

in furnace practice because it oxydizes less rapidly than steel. Cast iron is used for hearth bars, hearth plates, buckstays, doors and for outside angles and plates. From the diagram, Fig. 128, it is apparent that cast iron has a tensile strength of about 5,000 pounds per square inch at a temperature of 1,600 degrees F. From there on its tensile strength, roughly, decreases about 1,000 pounds per square inch for every 100 degrees F. increase in temperature. This figure is an approximation, because the melting point varies with the composition of the metal. The diagram also shows that, at furnace temperatures, malleable iron is no stronger than the ordinary grey cast iron.

When tensile strength at high temperature is to be combined with resistance to oxidation, protective coatings or else more expensive materials must be used. A recently introduced method of protecting cast iron and steel from oxydation, consists in forming a surface alloy of iron with aluminum. The method is known as "calorizing" and protects the iron or the steel from oxydation up to a temperature of 1,800 degrees F.

For still higher temperatures, nickel and its alloys may be used, because they combine high tensile strength with resistance to oxidation at annealing furnace temperatures. Several of these alloys are on

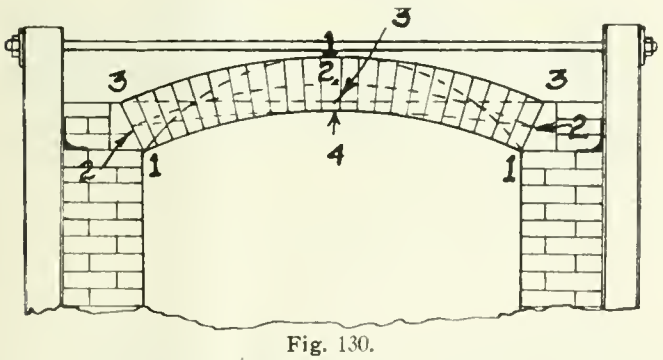


Fig. 130.

the market, such as stellite, chromel and nichrome. The latter material, for instance, has the following physical properties at a temperature of 1,472 degrees F. (Size of test bar ¾" diameter by 18" long).

	Cast Nichrome	Forged Nichrome Bar
Elastic limit, lbs. per sq. in.....	20,100	25,800
Ultimate strength, sq. in.....	24,500	29,900
Elongation, per cent	4	13.5
Reduction of area, per cent	4.3	26.7

The Driver-Harris Company, manufacturers of nichrome, have recently published information on an alloy, which is known as Q-alloy, grade X, and which is claimed to maintain its elasticity and strength up to 2,800 degrees F.

Unfortunately, the price of the nickel alloys is about 20 times as high as that of steel, which fact prohibits their use for structural purposes and limits their application to annealing pots, boxes, light chains, burner tips or other purposes that involve only small quantities.

There being no inexpensive metallic material for interior use in furnaces, the latter are built of what is known as "refractory materials," among which fireclay is undoubtedly the most important and the most generally used. It would be very desirable to have for this material, a curve showing tensile strength and compressive strength as a function of the temperature. Unfortunately, the values are not well defined, because firebrick softens gradually, and becomes viscous, which means that it flows very slowly under steadily applied loads. Its yield point is, for

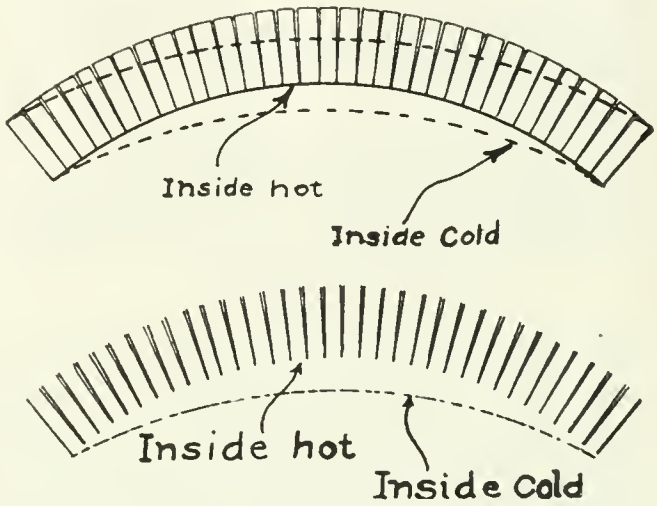


Fig. 131.

that reason, very difficult of determination, and the testing of brick for strength at high temperatures, following the path of least resistance, has determined other quantities, as noted below. However, Dr. Bleininger, of the Bureau of Standards, intimated that the compressive strength of firebrick follows, in general, the curve indicated in Fig. 129. Instead of testing bricks for the relation expressed in this illustration, it is customary to investigate whether the bricks will indefinitely hold a load of 25 pounds per square inch at given temperatures, which latter are 2,500 degrees F. for high duty, 2,400 degrees for moderate duty, and 2,100 for light duty. This test simply determines, whether or not the yield point, at the tem-

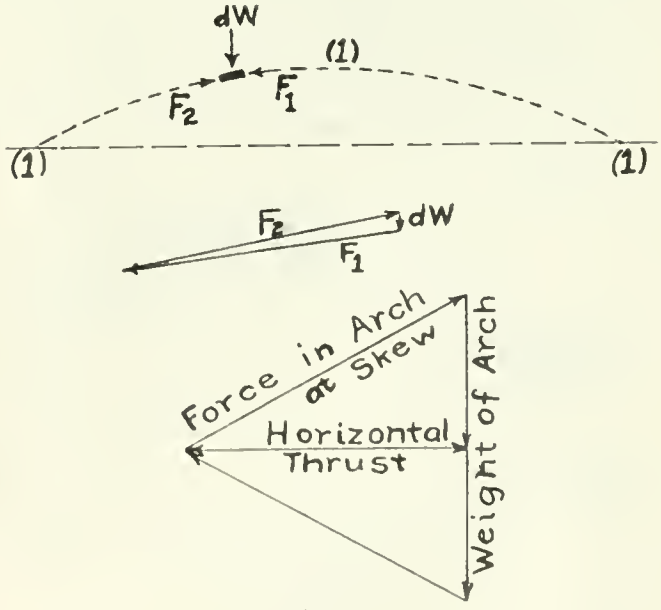


Fig. 132.

perature in question, lies above the value of 25 pounds per square inch. Additional tests of firebrick determine the softening point which for high duty must not be lower than 3,065 degrees F., for moderate duty

must not be lower than 2,912 degrees F., and for low duty must not be lower than 2,750 degrees F. The test reveals the fact that the yield point has been

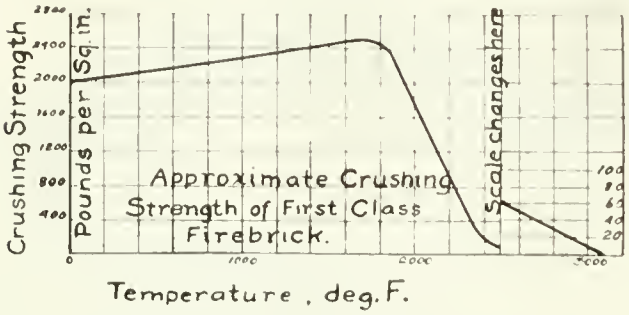


Fig. 133.

reached, but does not tell us the value of the yield point stress.

Bricks that are exposed to high temperatures must have been so well burnt that there is no further shrinkage of volume of the brick. Tests are frequently made to determine constancy of volume at high temperatures. Such tests are desirable if comparatively unknown brands or cheaper brands than those which are standard, are to be used. For test methods see the American Society for Testing Materials, 1919.

Finally, open or porous bricks absorb more quickly than do dense bricks, and are, in consequence, destroyed by slagging action more quickly. Test methods for resistance to slag penetration are likewise found in the 1919 volume of the Society of Testing Materials. These tests are carried out at a temperature of 2,462 degrees F.

Even if a furnace owner should subject brick samples to all of the above tests, there would still remain the possibility of some defective bricks in a shipment of otherwise very good bricks. This statement refers principally to hidden cracks. Good bricklayers will

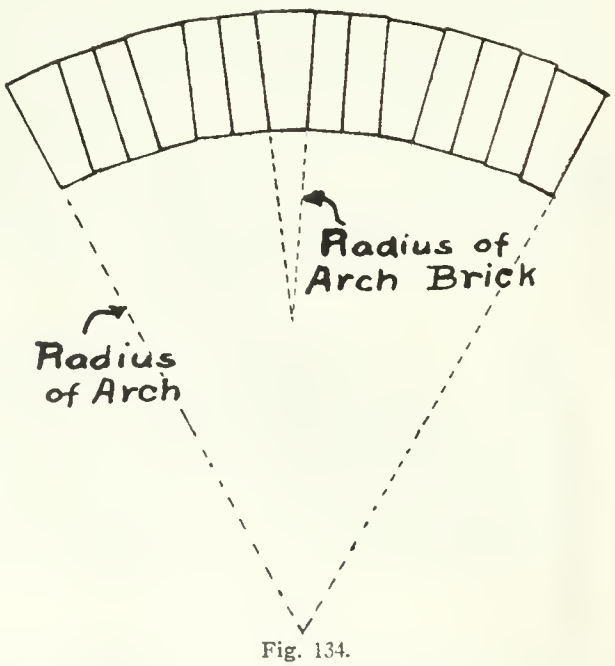


Fig. 134.

discover defective bricks by their lack of ring, when struck with a hammer and will place them where they will do no harm.

From the foregoing data, it follows that there should never be any trouble with refractories in the heating chamber of annealing furnaces and of heat-treating furnaces, provided that the refractories are not subjected to excessive tension or shear (see below). Trouble may, and often does, arise in high temperature furnaces such as forging furnaces, mill furnaces and the combustion chamber of annealing furnaces.

Keeping in mind the compressive and the tensile strength of fireclay, it will pay to investigate the place where failure is likely to occur. Prominent among such places are roofs. Whenever material spans a cavity, there must be tension in some part of the material; and since refractories are very weak in tension, the later is usually taken up by cold steel. The commercial type of furnace roof is the arch. The latter, while simple in construction, is complicated in theory, because it is three-fold statically indeterminate, which means that we have no definite knowledge of the stress distribution in the interior of an arch, unless we investigate the elastic deformation and the method of support of the arch. Depending upon the method of bedding, the center line of force may follow any curve which is compatible with stability, for instance, any one of the dotted lines (1) (1) (1), or (2) (2) (2) or (3) (3) (3), in Fig. 130.

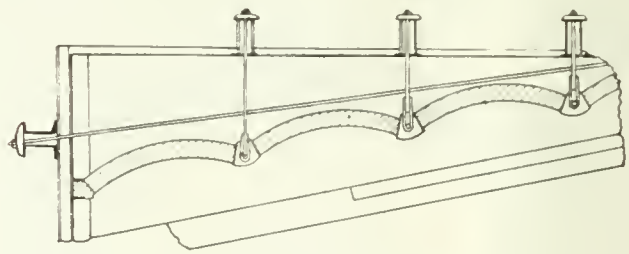


Fig. 135.

Since an arch is nothing but an inverted equilibrium polygon the internal forces are smallest, if they follow the line (1) (1) (1) and are greatest, if they follow the line (3) (3) (3). If the latter be straight, the stress would have to be indefinitely great, but, of course, that kind of stress distribution does not occur, because the terrific compression at the affected points would reduce the brick thickness and would thereby automatically transfer the stress to adjacent points. In the calculation of the strength of arches in furnaces, we must consider the interaction between arch on one side, and buckstays and tie rods on the other side. The stresses in the arch must not be so great as to crush or spall the bricks, and the abutment (formed by buckstays and tie rods) must be strong enough to resist the thrust exerted by the arch.

The stresses in furnace arches are quite different from those in masonry arches on account of the effect of high temperatures. Firebrick (consisting of fireclay) expands .075 inch per foot, or 0.6 per cent. This means that the inside of the arch expands, while the outside of the arch practically retains its original length. If the abutments are fixed immovably, the arch rises, the bricks tend to gap at the outside, and to touch only at the inner edge, see Fig. 131. This action throws the line of force down to the inner edge of the arch. If the line of force could maintain the just mentioned position, that is to say, if the bricks touched only at their inner edges, the arch would be utterly unstable, and could be swayed and moved just like a hanging chain, with the exception that,

after the disturbance has been removed, the chain regains its initial position because it is in tension, while the arch would keep on going until it either collapses or else some of the bricks touch at the top, and change the position of the line of forces. In reality, the line of forces will not be at the inner edge, but only near that edge, because elastic and plastic compression of the bricks distribute the load over a certain surface until the unit pressure has become small enough to provide no further deformation.

Before these facts are followed to a logical conclusion, the method of calculating the forces for a given line of action must be reviewed. In Fig. 132 let (1) (1) (1) be the line of forces in a given arch, then the weight dW, of an element of the arch must be in equilibrium with the arch forces F_1 and F_2. In the center part of the illustration the triangle of forces dW, F_1 and F_2 show how the forces are connected. In addition, from which the horizontal thrust and the thrust on the skews can be read off.

But as before stated, the location of the center line of forces within the arch is quite uncertain, and varies, not only with the temperature, but also with the elastic and the plastic properties of the brick and also with its co-efficient of heat expansion. We are,

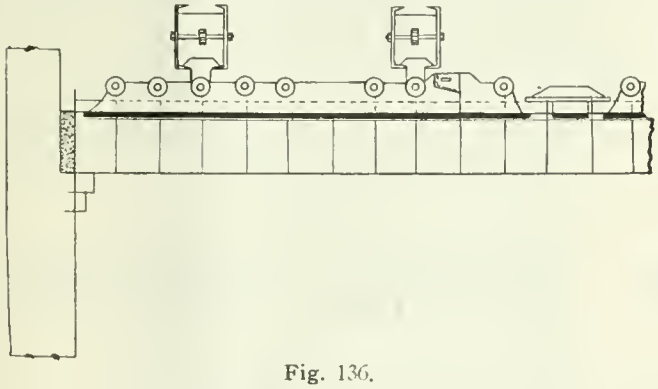


Fig. 136.

therefore, forced to make an assumption, and it will behoove us to make it so that it comes sufficiently close to the truth that it will serve for all practical purposes. We may, for instance, calculate the arch forces on the assumption that their center line coincides with the center line (2) (2) (2) of the arch, see Fig. 130. But from the knowledge that the line of forces shifts with the temperature, the forces found on the basis of the present assumption must be multiplied by a factor of safety which may be taken to be 2 for arches up to 1,600 degrees F., 2½ for arches up to 2,000 degrees F., and 3 for arches up to 2,400 degrees F.

Or else we may assume that the center line of forces follows the line (2) (4) (2), see Fig. 130, which line joins the center line of the brick at the skews to the inside of the brick in the middle of the arch (at the keystone).

With the first assumption, the unit stress in the arch depends solely upon its span (and its weight per unit volume) wholly dependent on its thickness, while with the second assumption, the unit stress in the arch grows with increasing thickness, provided, of course, that in neither case the arch carries a superimposed load. While the second result may have a spark of truth in it, it certainly leads to impossible stresses for very thick arches. In consequence, I prefer the other assumption, although it likewise leads to impossible conclusions, for we all know that a large arch of only ⅛ inch thickness could not be made to stand up. But this latter fact is due to the move-

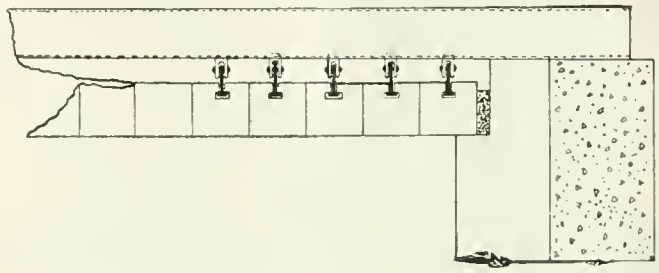


Fig. 136.

ment of the abutments, as explained below.

As a matter of fact, the roofs of heating furnaces seldom, if ever, fail from crushing of the firebrick. Occasionally, very hot luminuous flames melt the arch down; in some other cases ash from the grate or from powdered coal is blown against the roof causing a flux which melts the roof, but, as a rule, the collapsing of arched roofs is due to other causes, the most common among which is found in the yielding of the abutments (skews, skewbacks). The abutments yield for various reasons. In some cases, furnaces stand on poor foundations, which give way in spots. In other cases, the walls below the skewbacks give way, allowing them to sink. In still other cases, the tie rods or the buckstays become overheated, yield, and allow the arch to move. Weak tie rods produce a similar effect. As before mentioned, and as shown in Fig. 133, firebrick expands .075 inches to the foot. An arch, in heating up, must either rise or else stretch the tie rods. If the latter happens in an inelastic manner, the roof is doomed, because at each cooling the arch sinks down flatter, and, at each heating-up it stretches the tie rod a little more. Movements of this sort are hard on any arch and can be avoided by either manual adjustment of the tierod or by equipping each tie rod with a stiff spring. The latter yields when the arch expands, and, which is very important (returns lengthen), when the arch cools, maintaining the correct forces on the arch at all times and eliminating movements in the arch.

In connection herewith, it should be mentioned

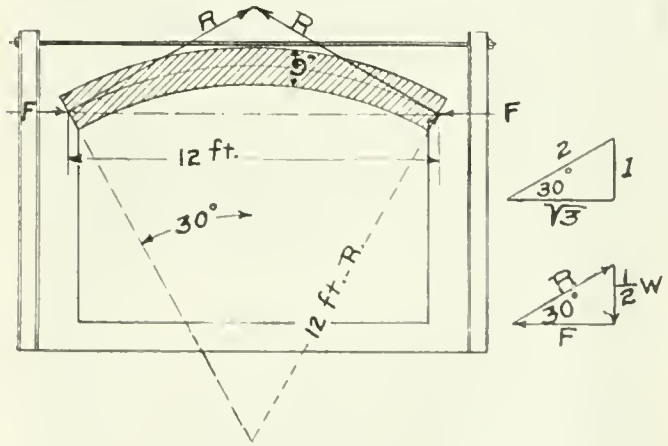


Fig. 137.

that arches are built up of alternating rows of several straight bricks and one arch brick, see Fig. 134. Brick makers cannot and do not make brick for every con-

ceivable radius. In consequence, we must take the nearest brick with a radius smaller than that of the arch, and must fill in with straights. A further result of this practice is that the straights are no longer individually held by wedge action, and could slip out if it were not for the frictional hold which the arch forces exert. Movements of the arch, and vibrations due to panting flames, occasionally overcome the frictional hold and endanger the stability of the arch.

An additional source for the collapsing of arches lies in explosions or in impact. Furnaces are occasionally filled with an explosive mixture of air and gas and are then lighted. The best furnace design and the best of firebrick are of no avail against this treatment.

Doors are occasionally slammed against the furnace, cranes bump against it, bricks projecting inwardly from a door, catch against door arches. All of these happenings interfere with the stability of the roof.

All of these facts taken together, and in addition, reasons of heat insulation, have resulted in making practically all furnace roofs 9 inches thick. When the span exceeds 12 to 15 feet (depending upon the temperature) the arch is often laid up of 13½ inch bricks. For spans of more than 16 or 18 feet, the total span is broken up into several smaller spans, see Fig. 135 or else flat roofs are used which are built from tile suspended from girders, see Fig. 136.

Several paragraphs above, the strength of buckstays and tie rods was mentioned. Since they act as abutments for the roof arch, the horizontal thrust of the arch contributes the force which the tierods have to take up. To illustrate this fact, a tie rod and spring will now be calculated.

Let the arch be 9 inches thick, 12 foot span, radius 12 feet (see Fig. 137), and let the buckstays be 3 feet apart.

Weight of arch section 3 feet wide =

$$3 \times \frac{9}{12} \times \left(2\pi \times 12 \times \frac{60^\circ}{360^\circ} \right) \times 120 \text{ lb. cu. ft.} = 3{,}400 \text{ lb.}$$

$$\text{Reaction } F = \frac{\sqrt{3}}{1} \times 1{,}700 \times \text{factor } 2\tfrac{1}{2} = 7{,}400 \text{ lb.}$$

Allow a total variation of force from cold to hot of, say, 25 per cent of the average reaction, of 1,800 lbs.

Expansion of arch equals:

$$.075'' \text{ /ft.} \times 12 \text{ ft.} = \frac{9}{10} \text{ inch.}$$

Spring scale equals.

$$\frac{1{,}800}{.9} = 2{,}000 \text{ lb. per sq. in.}$$

We must then use a spring which will sustain a load of 7,400 lb., with a deflection of 1 inch by 2,000 lb. load. From spring tables, this would be a spring of 6 inch outside diameter of coils, 1⅛ inch wire, 11 coils. If 50 per cent variation of force is allowable, a spring of 4¼ inch D. D., 1 inch wire, 10 coils, would be suitable.

The tie rod may have a stress of 10,000 lb. per sq. in., its area, then, must be $\frac{7{,}400}{10{,}000} = \frac{3}{4}$ sq. in. at the root of the thread. The nearest size is 1¼ inch diameter rod.

Pipeless Product from Annular Blooms

Description of a Proposed Method of Rolling Rails, Blooms, Billets and Bars Free From Piping and Segregation—Solution of the Railroad's and the Rail Manufacturer's Problem.

By C. A. WITTER,
Providence Engineering Company.

IN THIS paper I describe in general a new method of rolling lineal products, such as rails, blooms, billets and bars, by which process it is possible in a practical way to produce products free from piping and segregation, which means that the longitudinal axis of the ingot is entirely eliminated from any point in the cross section of the finished material, and at the same time increasing the yield from the ingot 15 to 20 per cent over the present accepted methods, and producing a more homogeneous product with an inherent physical structure superior to that now obtained.

The process described in detail, is a combination of existing proven practices involving the addition of only one new and novel operation, which is purely mechanical, and has been developed as it would apply to large tonnage products, such as rails, blooms, etc. This brief description of the process as would apply to the manufacture of rails in particular, as being the solution of a serious problem which today confronts the rail manufacturer and railroads alike.

You will admit, if we are to be guided by an interpretation of the revisions which have been applied to rail specifications over a period of years, that the principal chemical weakness of rails as at present manufactured is due to the fact that the axis of the finished rail coincides with the longitudinal axis of the ingot, wherein are contained all the defects, such as piping, segregation, etc. The gradual increase specified in discard alone apparently has not fully overcome the trouble arising from this source.

As the ingot in most practices is never allowed to become cold, it is liable to be bled when going through the cogging rolls. This naturally destroys the physical structure of the center or vital part of the ingot, which is scrapped. Even though the ingot does not bleed, it does not signify that the structure is solid throughout its entire length, as the cogging operation can be nursed to a point that will not bleed the ingot, but there is still no proof to signify that the structure of the center of the ingot is not destroyed.

The structure of the ingots in the various progressive stages of manufacture when going direct from open hearth to soaking pit and cogging mill without

permitting a permanent setting of the original ingot is only a theoretical conjecture, and may account for some of the present defects. While it is conceded that the piping itself can be largely eliminated with sufficient discard from the ingot, to further insure the elimination of the segregation would require a still greater discard, making it commercially prohibitive.

Fig. 1 shows the progressive steps involved in the manufacture of pipeless rails by method herein described. It was with the idea of eliminating the center or longitudinal axis of the ingot from the cross section of the finished product that suggested this process.

The manufacture of this type of ingot is described in detail in a paper by Lawford H. Fry, of the Standard Steel Works Company, and presented to this institute at the meeting in November, 1919, under the title of "The Manufacture of Ingots for Tires and Rolled Wheels."

After the ingot has been poured, it would be allowed to cool and then reheated thoroughly in a continuous furnace. The reheating accounts for the 3 per cent loss as shown on the margin, or, the hot ingots could be used as at present; but to insure freedom from the oxidized top of the ingot appearing in any point of the rail, would be necessary to use a punch of larger diameter than the diameter of ingot. This would slightly increase the percentage of loss in the punching, which would be offset, however, by the reduction in the heating loss to about 1½ per cent.

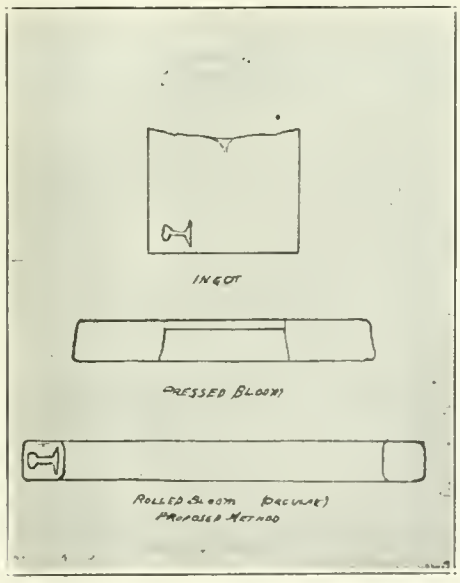


Fig. 1.

The ingot is then placed under a 10,000-ton hydraulic press and bloomed to the desired width. A hole is punched in the bloom in the same operation, removing piping and segregation, and to the required size to permit the bloom being placed over the pressure roll of the blooming mill, which is of the same general type as based in rolling tires. The bloom is then rolled to the necessary diameter, to give the required thickness of bloom.

The new and novel operation referred to in the second paragraph consists in the cutting and straightening of the circular bloom. Two methods of performing this operation are described in detail later. The straightened bloom then goes direct to the finishing mill where the finished product is to be produced.

You will note I have shown the rolled bloom of square section. This naturally brings up the question of crops due to the variation in length of developed surface between the inside and outside diameters. This is overcome by using a bloom, the inner half section of which has sufficiently greater area that when the cross section of the bloom is reduced to a square in the finishing mill, all surface measurements will be approximately the same.

The time cycle required for the forging, rolling and straightening operations would not be any more than is required on modern rail mills for producing the final size of bloom before going through the first shaping pass. By this process, there is accomplished in two operations that which ordinarily requires the first 8 to 10 passes on a modern blooming mill, thereby making it practical to complete the forging and rolling operations in one heat, as is done at present.

The process, however, applies with equal advantage to the special requirements of the automotive industry for alloy steels of the highest grade as used for crankshafts, connecting rods, etc., also to tool steel as well as shell and other ordnance steel requirements.

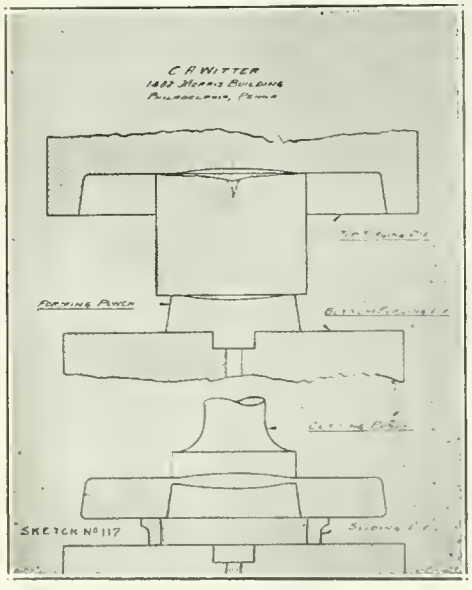


Fig. 2.

The advantages of the process described are:

1. Quality, which is accomplished by the elimination of piping and segregation, insuring a homogeneous product both chemically and physically.

2. An increased yield from the ingot. On the basis of 70 per cent yield in accordance with the accepted practice of today, 1,430 tons of ingots produce 1,000 tons of rails. By the use of the method described, 1,430 tons of ingots would yield at least 1,200 tons of rails, an increase of 200 tons.

3. Better physical structure. A better physical structure is assured as the ingot receives work in both directions.

Fig. 2 shows the method used in forming the bloom under 10,000-ton press.

You will note that both the bottom punch and the top die are cupped, which prevents the piping or segregation from spreading during the forging opera-

tion, and confines it in a double convex disc form, as shown in the lower sketch, which shows the bloom with the cutting punch in position ready to remove the burr or punching.

With this method of producing the bloom, the ingot is centered directly on top of the bottom punch, over which the ingot is forced down the required width.

The press is equipped with a bottom push-up cylinder, which has a ram shaft that extends through the center of the platen. This, after the bloom has been forged, is raised, which allows the sliding die to be placed under the bloom and gives it the necessary support while the cutting punch broaches the burr or punching. This, you will note, eliminates the necessity of turning the bloom and punching from both sides.

One method of splitting and straightening the circular bloom on the mill immediately after rolling to size would be as follows: The cutting is done with an adjustable swinging hot saw accommodating any

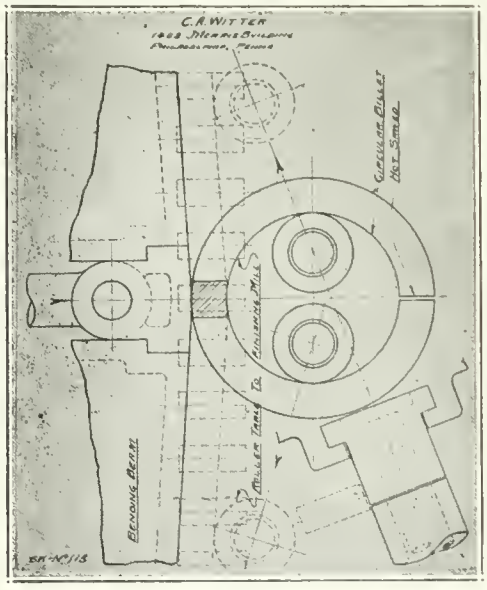


Fig. 3.

diameter of bloom, depending on whether the ingots were poured for single or multiple lengths. After the bloom has been sawed, the pressure roll would be advanced ahead of center guide the bloom through a pair of straightening rolls, which it would pass direct to the finishing mill.

Fig. 3 shows another method of straightening the circular bloom, and would be a machine independent of the blooming mill, making it a separate operation, and would be the means of eliminating two operations in the circular blooming mill, thereby materially increasing the capacity of same. This could be either a motor driven or a hydraulic machine, and could be designed to operate either vertically or horizontally, the latter being preferable.

The circular bloom would be hot sawed on the blooming mill, as this operation would be possible while the pressure roll was being drawn back in position to remove the finished bloom from the box pass in the main roll, thereby no time being lost during the rolling operation. The blooms would then be transferred on a roller table direct to finishing mill.

Fig. 4 shows a proposed layout as would be required for the preliminary operations up to and including the straightening of the bloom.

Roughly, the main bay comprises four double neck heating furnaces, being of the continuous type, which are served by two floor type manipulators which transfer the ingots from the furnaces to the 10,000-ton press.

The press is equipped with sliding die base, which is fitted with three separate punches, on which the operations are alternated, allowing sufficient time for cooling.

The bloom when punched is carried by a transfer table to the adjacent bay of the building, where it is placed by another manipulator on the circular blooming mill, hot sawed, and transferred by manipulator to the straightening press. After straightening, the billet is carried on the transfer table to a three-high finishing or continuous mill, which could be part of any present installation.

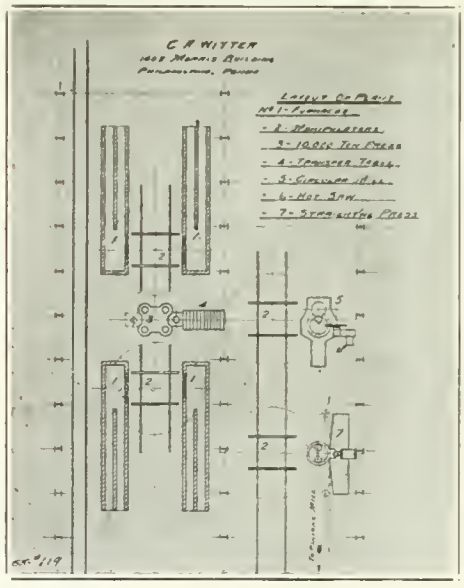
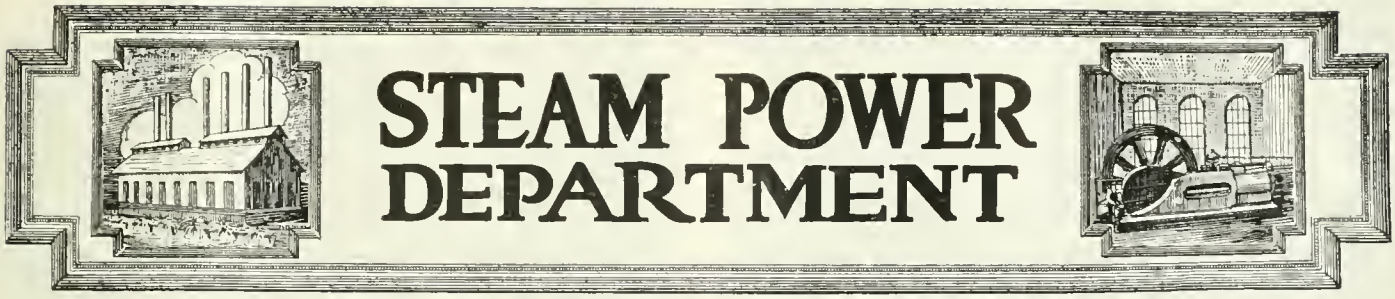


Fig. 4.

This gives a general idea of the progressive steps involved in the manufacture of pipeless products. Many of the claims made above have been substantiated by chemical and physical tests made by the Lackawanna Steel Company from experiments which were rolled at their plant April 1, 1920. The rails were rolled from two 12x12 inch, 5 foot 8 inch bloom, the blooms being made by the process described for each of which a 23-inch diameter octagonal acid open hearth ingot of the following analysis:

Carbon	.70
Silicon	.20
Phosphorous	.042
Manganese	.56
Sulphur	.039

The report of these tests were really amazing and the writer desires to extend his thanks to the officials of Lackawanna Steel Company, and also the Standard Steel Works Company for their assistance in the development of this method.



Operating by Powdered Coal to Save Fuel

Giving the Operation of a Powdered Coal Plant and Demonstrating the Possibility of Reducing the Cost of Operation by Its Use as a Fuel Including a Complete Description of Equipment.

By A. C. COLE.

THE early operation of a powdered coal plant has been and will continue to be a very trying period to any organization that is unfamiliar with the very many apparent difficulties which will be encountered. However, these apparent difficulties automatically disappear if they are faced squarely with a small degree of patience, mingled with a little of that determined effort which is evident at the majority of our industrial plants of today.

During the early days of the operation of our powdered coal plant, there were many of those days when the writer, if it were in his power, would gladly have traded the entire powdered coal installation for a dozen of golf balls and proceeded at once to use them and forget there ever was such a fuel as powdered coal. This was before powdered coal was acquainted with our operating conditions. The reader will kindly note our definition of the acquaintanceship. Our reason for this is that we believe the majority of all fuel users are acquainted with powdered coal; the only problem is to allow powdered coal to become acquainted with your operating conditions.

The writer wishes to be clearly understood that he is not interested in the manufacture or selling of powdered coal equipment in any manner whatsoever. We do, however, attempt to describe from actual operating conditions our experience with the use of powdered coal as a fuel.

Description of the Powdered Coal Equipment.

The initial installation of the plant was for large heating furnaces, used in the manufacture of rolled steel wheels. This plant consists of required elevators, conveyors, one 15-ton crushed coal dryer, one 5-ton per hour Bonnot pulverizer, powdered coal bins, blowers, cyclone collectors, etc.

As stated in the beginning of this article, our early operations were very discouraging. Our progress was slow as is characteristic with any new development in connection with operating conditions. However, as our acquaintanceship developed a very strong business friendship has cemented powdered coal so firmly to our heating conditions that our feeling for this fuel is as solid as the rock of Gibraltar.

Comparison of Hand Fired Coal and Powdered Coal Furnaces.

Our geographical location confines our comparisons to hand fired coal and oil fired furnaces. Our experience in comparing powdered coal and hand fired coal demonstrates a saving in coal consumption of 30 to 40 per cent, a saving in labor cost equal to approximately 15 per cent of total coal cost. Another very important factor is the handling and disposing of ash, as the handling of ash from hand fired furnaces is equivalent to 15 per cent of coal cost. Location controls this cost.

In one of the departments, in which are located eight large heating furnaces which burn 350 tons of powdered coal per week, the ash and refuse is disposed of once each week. This accumulation is cleaned from one underground flue that furnishes the ventilation for the eight furnaces. This flue is 6x6 feet and 300 feet in length, and terminates into a 6x100 foot radial brick stack. We might mention that this ash and residue from the 350 tons of coal is all handled in one small side dump car of eight cubic yards capacity. The size of the flue and stack provides a very efficient draft for the furnaces, which in turn gives very good operating conditions.

The coal is delivered to these furnaces by the Holbeck low pressure air distributing system at approximately four ounce pressure. We also supply at about a three-ounce pressure the required amount of secondary air necessary for complete combustion. Our experience has proved that the most advantageous results may be obtained by the use of very low pressure in the air systems. Our present aim, in any of our additions to the powdered coal system, is to avoid velocity, to have sufficient volume. The express purpose is just merely to deliver the coal to the furnace and provide ample stack capacity to do the work.

Comparison of Fuel Oil and Powdered Coal.

The application of powdered coal to forge shop furnaces was an expedient to eliminate high priced fuel oil, also to use the available surplus capacity of the coal pulverizing plant. This so-called expedient proved to be a very wonderful demonstration of the true value of powdered coal as a fuel. In view of the fact that our present application to forge shop furnaces is temporary, and assuming fuel oil at 8 cents per gallon, powdered coal at $6.50 per gross ton, the savings per ton of forging is controlled principally by the size and weight. In our case

where we work mostly 16 to 24 inch ingots and with a variation in weight from 2,400 pounds to 8,500 pounds each, the saving by the use of powdered coal from actual conditions show from 30 to 60 per cent.

Powdered Coal in the Annealing Furnace.

We also have powdered coal applied to annealing furnaces, used for the annealing of steel castings. This application superceded hand firing. The change in results were very pronounced. One of the most noticeable results was in the time consumed for each anneal. This time was reduced 50 per cent. The physical tests show very uniform results, and the appearances of castings in general show a decided improvement.

At the beginning of our use of powdered coal we were full of the theory that nothing but complicated mechanical mixers and feeders would ever give results in the application of this fuel to the furnaces. We also had the theory that our velocities for either a sharp or a mellow flame should be exactly a certain number of feet per minute. Now some of these points are well taken and can be a very useful guide in the application and use of powdered coal. However, the largest of our problems is to get the coal to the furnaces, and I assure you with a little judgment on the part of the furnace operator and some ordinary wrought iron pipe we get results and show a saving on the proper side of the ledger.

Use of Powdered Coal in Forge Shops.

The application of powdered coal in our forge shop covers a wide range in furnace design and furnace size. The largest sized furnace has a content of 1,700 cubic feet, while the smaller furnace has a content of 28 cubic feet. The results are equally good from all sizes.

In our various uses and experiments with powdered coal as a fuel, we have determined to our satisfaction that the flexibility of applications are unlimited, that is, that powdered coal is applicable to almost any conditions requiring fuel, by careful thought and study to the burning conditions desired. As a brief illustration the writer will state the results of some temporary heating required in performing some special work.

The nature of this special work required an arrangement very much out of the ordinary. After some experimental work we finally adopted for this work a circle of 1½ inch standard pipe bent to a 9-inch radius which gave us an 18 inch circle of 1½-inch pipe. Through the top side of this pipe we had a 3/16 inch hole drilled circumferentially at a 20 degree angle from vertical center line, one row of these holes on each side of this center line, 2½ inches from center to center of hole. The one end of pipe was welded shut, while the other end served as the supply for powdered coal and air. The coal was syphoned from a small tank by air at about 40 pounds pressure. This air also served as air for combustion. The coal was discharged from pipe circle through the 3/16 inch holes. After some very slight adjusting of coal and air supply, we had a very combustible mixture which proved very easily ignited, also very easily controlled, which naturally allowed any degree of heat desired. The heating results from this arrangement were very satisfactory indeed, and also served as one more step in our education of the many uses that it is possible to make of powdered coal as a fuel.

Welfare Work in the Steel Industry

Interesting Review of the Safety, Sanitary and Welfare Bureau's Work as It Is Carried on Among the Employes of the United States Steel Corporation and Its Subsidiary Companies.

By C. L. CLOSE,
United States Steel Corporation.

PART I.

IN THE early stages of the development of the iron and steel industry, little attention was given to the conservation of human resources, or to conditions in general, under which employes worked and lived. Industrial pioneers in this country, were confronted with many intricate and complex problems; they labored under difficulties which only men of strength and character could endure, and so occupied were they in the development of processes and in striving to become the leaders of the world in manufacturing that the human side of steel making was a subject not included in the daily routine of their activities. They had not yet learned what could be done in this direction.

We stand first among the steel making nations of the world today, a position which is due to the courageous spirit of these pioneers. History records that the first furnace for smelting iron in the United States was built on the James River, in 1621, by Englishmen under the guidance of John Berkeley. The industry was new, the country undeveloped, the Indians hostile, and, of necessity, guns were an important part of the equipment at the furnaces. And so an industry, which was destined to eventually lead the world in the production of iron and steel was introduced in this country. But it was not until after the Civil War, about 50 years ago, that activities were inaugurated which were to place this country in the foremost position among the nations of the world in the manufacture of steel. It required men of courage in those primitive days, with the meager facilities at their disposal, to lay the foundation of this industry, and required men of determination and perseverance to develop it to its present magnitude. There has been developed, in approximately 50 years, an industry employing over 600,000 people and producing annually more than $1,600,000,000 worth of the material most essential to our civilization. Over and over again these men risked all they had in the world, lost everything and afterward won back more than they had lost. Considering the almost unsurmountable obstacles which these men faced and the difficulties under which they labored, any criticism of them for failing to recognize the finer details of the human side of steel making is unjustified.

Abstract from paper as read before the American Iron and Steel Institute.

With the development of the industry and the gradual perfection of the product, the attention of the industrial manager was naturally drawn to the finer details of steel making bearing upon efficiency and economic production and from his close scrutiny and study of the economic situation were evolved many changes which have revolutionized practices, processes and equipment. No doubt, many of you will remember the old days, not so long ago, when production was the paramount issue, in the steel mill. It was the aim of the plant officials to produce; to keep the wheels turning and the mill in operation with very little effort to stem the yearly sacrifice of life and limb of those who had associated themselves with the industry. It was not that anyone wanted men to be injured, but the human side of steel making was a matter which was not seriously considered and accidents were treated as a necessary and unpreventable evil, one of the hazards of the business.

But times have changed; production essentially is still the ruling factor; but activities, based upon sound and broad policies, have been established to protect the workers. Every endeavor is being made throughout the industry to create environments in the plant, home and community, of a character which will contribute to the workman's happiness, health and comfort, to foster within him a spirit of contentment and coöperative interest in his work, and to insure him against serious injury and physical disability, which may, in any way, affect his earning power or standing as an efficient producer. With the fuller realization of the importance and necessity of welfare work in our industrial establishments, these activities have gained such earnest recognition on the part of the employers of labor that welfare work may today be classified as one of the essential features in successful and efficient plant management. The results which have been obtained since the inauguration of the intensive movement have been, in most respects, very gratifying. Thousands of workers have been saved from serious injury or death. Their health has been preserved through study and correction of mechanical processes which, in former years, have proven injurious. Customs and modes of living have been materially improved and better morale has been established in our industrial forces.

Primarily, this great movement in the industrial world was purely humanitarian, a manifestation of the sympathetic feeling the average person must feel toward his fellow men, and in no direction perhaps, has there been a more shining example of the application of the Golden Rule so dear to the heart of the honorable president of this institute. To him, and to the other leaders and their associates in this great industry we owe much, for it was through their foresight and untiring efforts, backed by financial support, that the work which is being carried on in our manufacturing establishments and industrial com-

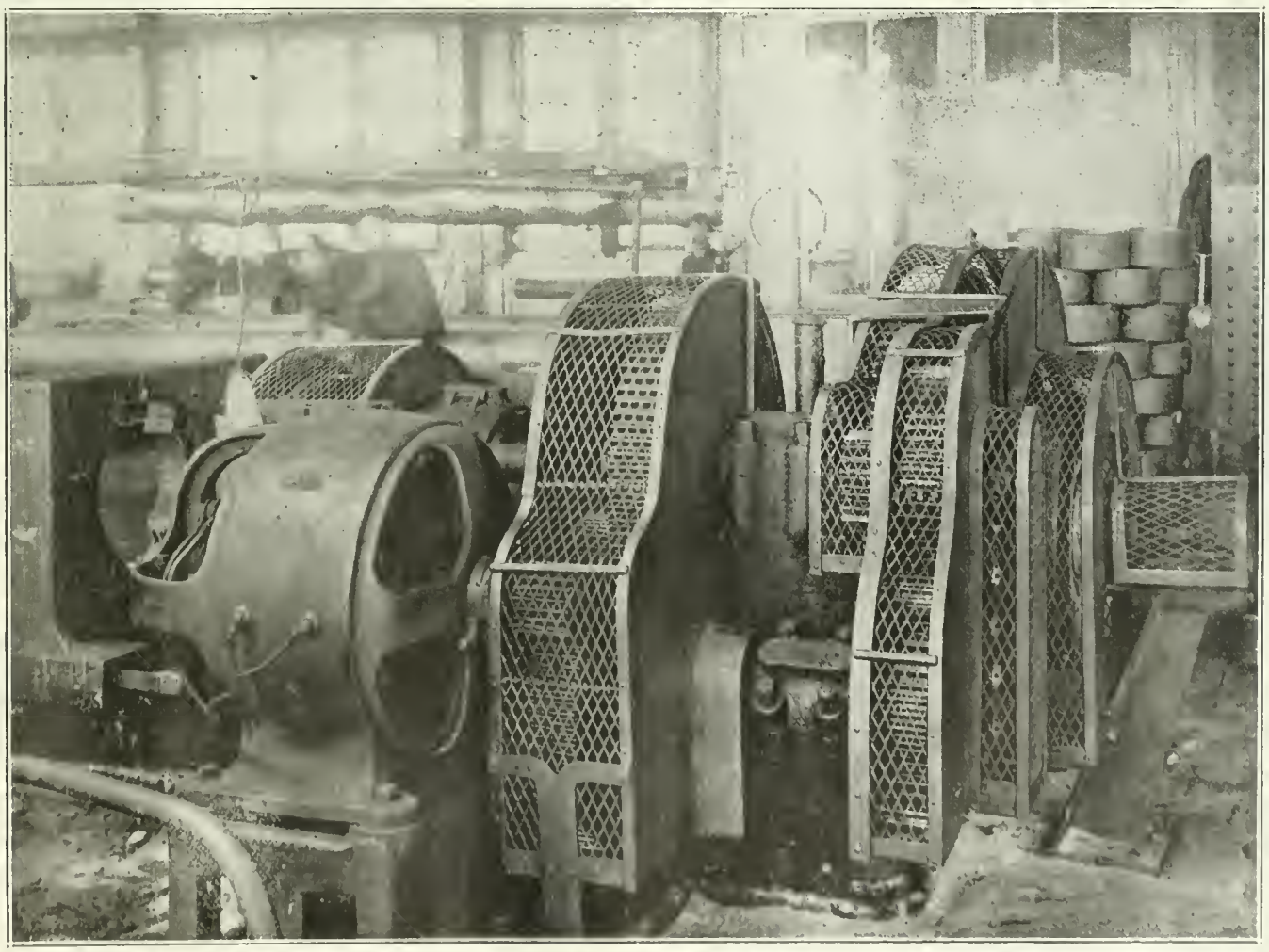


Fig. 1—Showing guards over lathes on pipe mills, National Tube Company.

munities today was made possible. The excellent cooperation of the members of this institute has done much to promote welfare work, and the monthly bulletin, published by the institute, was a fruitful source of information.

Let us see what large corporations are doing to solve the present day problems. In covering the various subjects, I shall dwell particularly upon the work of the United States Steel Corporation and its subsidiary companies, with which I am most familiar; but these are analagous in many ways to the activities as conducted by other large companies of the iron and steel industry.

Organization.

While in recent years some thought was given to the human side of steel making by the large companies, and various attempts were made to improve conditions, there was no concerted or organized effort until after the formation of the United States Steel Corporation. In order to systematize and standardize the work that was being done by the subsidiary companies, the steel corporation, in 1906, inaugurated activities which resulted in the appointment of committees to study these matters. As a result of this investigation a safety committee was appointed, consisting of representatives of the corporation and the larger subsidiary companies, who had already given some study to the subject of accident prevention. This committee has been continued and now meets periodically to consider all phases of accident prevention activities, to pass upon safety devices, study serious accidents and recommend remedial measures to prevent the recurrences of similar accidents.

Fig. 2—Carey rail mill method of guarding shafting, wheels and chains, also showing viaduct at the mill.

Owing to the success of the work undertaken by the safety committee, other committees were appointed, both in the corporation and subsidiary companies, which greatly augmented the scope of the work and its usefulness. This necessitated the organization of a central station to assist the efforts of the committees and all other endeavors which were being made among the subsidiary companies to improve the conditions of their employes. Accordingly, in March, 1911, the Bureau of Safety, Sanitation and Welfare of the corporation was organized of which I have the honor to be in charge and my entire time is given to the supervision of the work, and obtaining information and disseminating it among the subsidiary companies.

The bureau carries on the administrative work of the various committees dealing with these subjects. It distributes to the subsidiary companies comparative statements on accident prevention, compiled from reports submitted by the companies periodically, thus enabling each company to benefit by the experience of all the others. While the bureau was established primarily for the benefit of the subsidiary companies of the corporation, it is constantly in communication with state and national authorities, with other employers of labor and with many other persons, including representatives of foreign countries, engaged or interested in this work. From many sources it obtains valuable information on these subjects, and keeps the subsidiary companies informed of the latest and best methods of accident prevention and welfare work. It was realized from the beginning that cooperation among those carrying on this work is a valuable feature. Scarcely a day passes without a call from some individual, or committee, interested in the welfare work of some company or corporation, for the purpose of securing information regarding the general plan of certain specific details of the work.

Accident Prevention.

The good resulting from the work of the corporation's safety committee led to the appointment of safety engineers and supervisors, and other safety committees, including a central committee of safety for each subsidiary company, composed of representatives from the different plants of the company. The duties of this committee are similar to those of the corporation's safety committee, but with reference to its particular company only. There are also plant safety engineers and committees, composed of important officials of the plant, whose duties are similar to those of the central safety committee, but with reference to their particular plant only; and there are department and special committees consisting of foremen, master mechanics and skilled workmen, who investigate particular problems, and workmen's safety committees from the rank and file of the mill, including even the foreigner who cannot speak English. The functions of these mill committees are to assist in establishing safer and better working conditions for the employes by making a study of the general conditions, departmental and occupational hazards and practices, and endeavor to encourage the cooperation of their fellow-workmen in promptly reporting for correction any existing unsafe conditions or practices through which personal injury may result. These committees meet at least once a month for the purpose of making formal departmental or inter-departmental inspections; also they review accidents, suggest remedies—physical or operating—and render full reports with recommendations, to the chairman of the plant central safety committee. The members of the plant committees represent, as far as practicable, the various occupations, and membership is rotated frequently in an endeavor to have as many men as possible serve upon these committees. Up to the present time, some 26 000 employes have served upon these committees, and there are now about 5,500 men so serving. This, in addition to 101 safety engineers and supervisors who devote their entire time to accident prevention work.

General requirements for safety have been prepared by the corporation's safety committee, for the guidance of the subsidiary companies, and each subsidiary company has prepared safety standards and

specifications for plant construction and the purchase and installation of machinery and equipment. An endeavor is made, when constructing a new plant, or department, or when installing machinery or equipment, to have safety given equal consideration with construction features so that all safety features may be properly installed with the completion of the new work. By so doing the protection of the workmen against the ordinary hazards incident to machinery operation is insured at the time of the initial operation of the equipment, and the expense incident to installing safeguards in the field is obviated.

The results of the work on accident prevention have been very gratifying. The serious and fatal accidents are about one-half what they were in 1906, and it is estimated that in the time convening we have saved 25,853 men from serious or fatal injury. The total number of disabling accidents—that is, accidents which cause a loss of time of greater duration than the balance of the working turn—have been reduced in some instances, as much as 97 per cent. To date approximately $10,000,000 dollars have been spent in providing safeguards, and the correction of conditions which are responsible for accidents.

Experience has taught us that fully 80 to 90 per cent of industrial accidents can be eliminated if steps are taken to organize the work properly. It has also taught us that from 70 to 80 per cent of all accidents occuring are attributable to thoughtlessness and carelessness either on the part of the workman himself or fellow workmen. It is quite evident, therefore, that considerable attention must be given to educational measures in which the workman is taught the fundamental principles upon which successful accident prevention is constructed, and to the inculcation of care and forethought which will overcome careless habits. Those engaged in conducting the safety activities in the steel corporation have been impressed with the importance of this feature of the work, and every endeavor is being made to establish hearty coöperation. This is done through timely instruction at the time of employment, departmental safety meetings, safety rallies, safety poster bulletins and propaganda which will reach the employes through the medium of bulletin boards, conspicuously placed throughout the plants; safety precepts printed on the back of pay envelopes or occasionally inserted in the envelope, and through safety literature in the plant paper, where there is such a publication. Several safety motion picture reels have been produced, which tell a strong story in picture form, and which all can understand. These are used quite extensively for educational work in the plants, and at large safety rallies to which are usually invited the workmen and their families.

Statistical data prepared a few years ago by the government, based upon careful investigation, indicates that the steel mills in this country are the safest in the world. A study of the accident experience in the German steel mills, which country we all know is well advanced in the art of steel making, shows a rate of accident frequency covering fatalities, permanent and temporary disability over a period of 13 weeks, of over 17 per thousand men employed as against a rate of about 10 per thousand men employed in the mills in this country. It was found that only one plant in America, among those covered by this investigation, had a frequency rate greater than that mentioned above for Germany. This is indeed an excellent showing for the American steel mills and one of which we may be justly proud, the more so in view of the fact that accident prevention is a subject which has been given considerable attention by German manufacturers.

The material reduction of life insurance rates for steel mill workers by one of the largest insurance companies in America, after an exhaustive study of the situation, is a further indication of the progress which has been made in the steel industry in this country in the prevention of accidents. In 1908 most of the occupations were classed as hazardous, whereas at the present time not a single occupation or group of employments is so classified.

First Aid and Rescue.

Recognizing the fact that with the utmost care and the protection afforded by the most approved safety devices and apparatus, accidents will occasionally happen, the subsidiary companies have made provision for prompt attention and skilful care of men who are injured. In all of our mining companies, and in many of our manufacturing companies, first aid and rescue crews have been organized, composed of four to six employes, who are especially trained under the direct supervision of the company doctors. This service is purely voluntary on the part of the employes, but before they are permitted to enter a training class they must obtain a written statement from their physician certifying as to their physical fitness for the work and the duties incident thereto. The course of training usually comprises 12 lessons covering lectures, drills and demonstrations, and upon completing the course, a certificate is given to each employe who has successfully qualified for the work. There are at the present time 62 training stations throughout the operations of the subsidiary companies, and since the inauguration of this work approximately 16,881 men have received instruction.

Fig. 3—Handling drinking water by a modern method at Carnegie Steel Company.

The primary object of first aid and rescue work is to have specially trained men take immediate charge of a situation where life is imperiled, as in the case of a serious or extraordinary accident, to give prompt and proper attention to injured men and provide aseptic or clean dressings that will prevent infection in the wound. The excellent work of these first aid and rescue crews has been effectual in reducing the number of infected cases to a minimum.

INDUSTRIAL RELATIONS

PLAIN FACTS ABOUT IMMIGRATION.

By William H. Barr, President, the Inter-Racial Council.

In discussing immigration, a few plain facts are better than a million prejudices. The United States has always depended upon immigration. The unskilled labor that has done the digging, hauling, track laying in this country, is a reminder of the service rendered by the immigrants of the past. As the American children of immigrants have prospered, these descendants like other Americans, sought other and more attractive tasks. So one wave of immigration after another has followed with pick and shovel, pushing up the wave ahead to a better wage level, and in time being itself pushed up by still another wave. And because there are so many more resources in the United States to be developed, the call for unskilled labor goes steadily on.

During the war, the net increase of immigration was negligible. Our people did a big war job, and a good one, but in doing it, other big jobs like the making of new rights of way, and the building of new homes had to wait. We are short of these things now, and never before have we realized the lack of them so keenly.

Almost everybody supposed there would be a tremendous rush from Europe when the war was over, not only because of our needs, but also because of conditions over there. The great rush has not come yet, though many of those who prophesied it would, do not seem to be aware of the fact. Already they are talking about the hordes of laborers that are going to swamp this country, and about the dangers that threaten us. We are gaining a little on immigration in numbers, but we are losing, not gaining, on the number of unskilled male laborers.

As after every war, there has been a great deal of industrial unrest, and it has not been limited to any class. These people that are afraid of immigration are the ones who attribute all the unrest to the foreign born. If a man cannot speak English, they seem to think he is an anarchist or something worse. For such a state of mind, the wonderful record of the foreign born in the United States, their military service, their enormous purchases of stamps and bonds, all count for nothing. It must be part of the post-war psychology. A lot of usually sensible people can work themselves up into a fury of suspicion and condemnation without reference to the real facts.

Of the foreign born immigrants in the country today, it may be said that as a whole, they are attending to their regular business. Among them here are, of course, professional agitators, although most of these are native born. But the general body of immigration is honest, industrious, and loyal, and it resents the suspicion and attack to which it is subjected. Immigrants are called by contemptuous nicknames. They are threatened in some states with the loss of their press, the only one they can read. In other states, they are penalized, even to the extent of being denied the right of earning a living unless they become citizens, as though the sacred right of citizenship were something for barter—to be sought at the price of a job. It is questionable Americanism to force this sacred right instead of treating it as a very special and splendid privilege open only to those who long for it.

These immigrant workers among us hear a lot about Americanization, but too often of the wrong kind. When a self-respecting laborer is talked to in the strain that a traveling evangelist might address the village drunkard, when his language, his people, and his customs are ridiculed, when the attitude towards him implies that he has neither an opinion worth expressing nor an intellect worth using, then, like any other person who earns his pay, he does not like it.

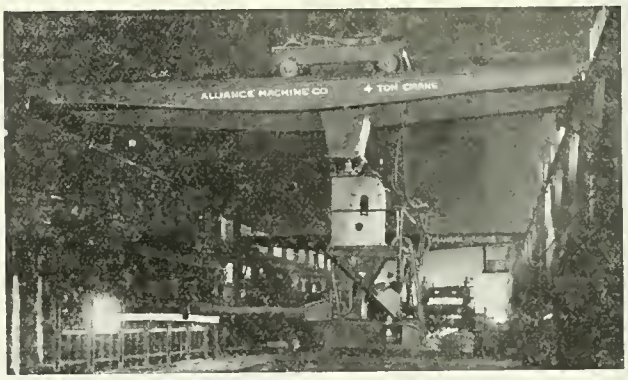
Immigrants are being subjected to mischievous propaganda all the time, and if they listen, it is usually because the people who are engaged in this propaganda talk to them as equals, as decent human beings, and not as objects for "uplift" treatment. If they are restive and resentful, it is because they feel they are misunderstood. But they would stand with us staunchly if any trouble came, just as they did before. Of every hundred newspapers published in foreign languages in the United States, more than 90 are loyal to America.

Conditions in Europe are bad for a poor man, yet a great many of the immigrants here, who used to invite their relatives to come over, are now going back themselves. Those who are coming in are mostly women and children; those who are going out, and the ships are filled, are for the most part strong, healthy men who would be good citizens anywhere. The "intellectuals," that is, the professional trouble makers, want to stay here, for their pockets prosper on a gospel of discontent. Incidentally, it may be remarked that these are the ones who are not kept out, and will never be kept out by any literacy test.

As to future immigration, the alarmists need not worry. If every ship available today were packed to a capacity on every trip for the next two years, they could not bring over here more than 1,500,000 for factories, farms and households, all of whom the country needs. And this assumes that not a single foreign born resident would leave here. Compare this with the falling off in immigration alone of more than 3,000,000 during the war, and talk about an "invasion" becomes absurd.

When Europe gets on its feet, the old political and religious oppression will have disappeared, or have been greatly reduced. True, the countries there will be badly tax-ridden, but the ordinary worker will not be the greatest sufferer. He can find abundant opportunity in Europe itself, for the devastated regions will need him and pay him well. Canada, Argentine, and Brazil are all working for the immigrant, and some of them are offering inducements. Of all the countries needing the immigrant, because of its undeveloped resources, ours is the only one that abuses him.

But this is the best country for the immigrants to come to, and notwithstanding the misrepresentation which they have suffered of late, most of them know it. Give them fair treatment, and they would rather come here than go elsewhere. But it is not a question only of whether the immigrant will be admitted. If we permit him to come, we shall have to assume certain responsibilities we have been neglecting in the past. We have never had any whole-hearted, nation-wide scheme of education. Our tacit consent has permitted immigrants to be despoiled and exploited, for the most part by his kinsmen, but in the face of our indifference. Like many other things, we have left the whole question of immigration to chance, and we are learning now that that method has its penalties. We must have a constructive policy on immigration.



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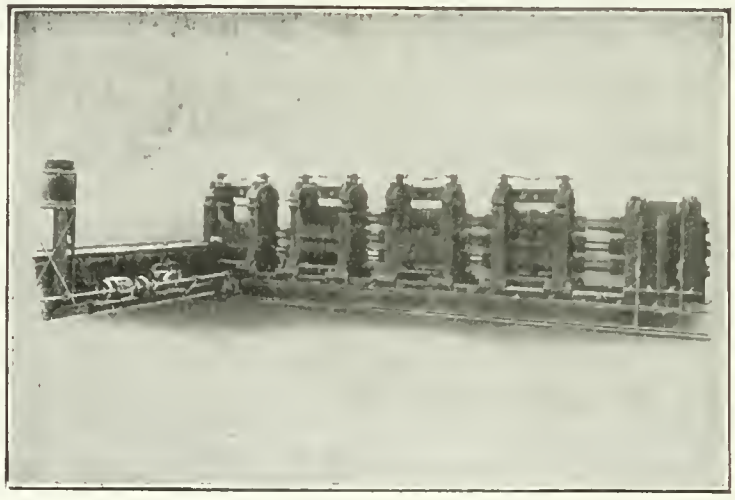

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FOREIGN RELATIONS

RECONSTRUCTION OF FRENCH INDUSTRY.

The French steel and iron industry is faced by an 8-to-10-years' task of reconstruction, says the Associated Press correspondent visiting the devastated regions of France.

Engineering experts, however, say the country's steel and iron production may be much quickened by the mining and metal-treating plants of Lorraine, returned to France under the terms of the Versailles treaty. The seriousness of the loss to the industry by war, nevertheless, is heightened by the great necessity for metal construction throughout the liberated districts and the dependence of nearly 150,000 inhabitants of these regions upon the blast furnaces and metal mills for a livelihood.

In Valenciennes, Denain, Trist, St. Leger, Fresnes, Auzin, and other towns of this district, the destruction suffered as a result of the conflict is estimated at 98 per cent, including the obliteration of the Denain and Anzin works, which were the most important in France.

Of the more than 500 small metal-treating and metal construction plants of the devastated region, Government reports show that 47 per cent have resumed work, but with only 14 per cent of the pre-war force. This does not include the large plants, which alone are said to be capable of meeting the country's chief needs in the way of structural material and important machinery taken away or destroyed in the course of the war.

No note of pessemism is intended, it is said, by engineers who forecast a long period of reconstruction before the nation can regain her former place in the iron and steel industry. These men, in support of their position, cite the fact that the work of clearing away the debris of war has not yet been begun at the largest mill, and they say that this is due to the necessity of designing a huge plant, with equipment to cost millions of dollars, and to other preparatory considerations. Actual accomplishments to this end, they say, are being delayed also by the general conditions holding up all construction projects, such as lack of transportation facilities, labor troubles, and shortage of coal and fuel.

It is asserted, however, that progress will be certain and steady with the attainment of half production within five years.

At present many of the smaller plants are said to be devoting their output to the most needy fields. In some instances several small concerns have combined their equipment, inadequate for separate operation, and have thereby created a group of little mills and shops capable of rapid action and able to help in some measure in supplying the crying needs for machinery of all sorts.

Some of the bigger companies are said to be acting deliberately because of the high prices demanded for the equipment necessary for their plants. The unfavorable rate of exchange also, it is stated, has added to this disposition to hesitate, together with the hope that prices will come down within two or three years.

PATENT-FUEL INDUSTRY OF SWANSEA, WALES.

(Consul A. B. Cooke, Swansea, May 5, 1920.)

There are now in operation in the city of Swansea five patent-fuel works, and one at the subport of Port Talbot. These works are engaged in the production of briquets or ovoids (egg size), largely for shipment to continental countries. Port statistics show exports of patent fuel from the ports of Swansea and Port Talbot as follows: 1918, 1,014,603 tons; 1919, 1,092,803 tons; first three months of 1920, 329,402 tons. Swansea is the chief center of the United Kingdom for patent fuel.

The fuel works require for the manufacture of their product great quantities of tar and pitch. These materials they must bring in from abroad, as there is no production of them in Great Britain. Several of the works are looking for connections with the American market with a view to purchasing supplies there. Their coal (dust) for manufacture they secure as a by-product of the local coal mines, this being one of the chief mining centers of Great Britain.

A BELGIAN INDUSTRY RECOVERS.

Window glass production in Belgium has probably been more completely revived than any important Belgian industry. At present two-thirds of the existing furnaces are in operation, but the average production has been so increased that output has now practically reached the level of July 1,914. It should be remembered, however, that in the period immediately preceding the war there was a slump in the Belgian glass industry; in the early part of 1914, for instance, only about two-thirds of the working force was employed.

There has recently been considerable comment in the Belgian press on the efforts of Great Britain to enlarge its glass industry and the acquisition by a British syndicate of the Fourcault patent for the mechanical blowing of glass.

Before the war Belgian manufacturers were able to compete with plants in the United States and other foreign countries, using mechanical blowing apparatus, without difficulty, chiefly on account of the great efficiency and comparatively low wages of the Belgian operatives. There is naturally no tendency to attempt mechanical production at this time when the installation costs would be almost prohibitive, and demand is heavy.

FIFTY-SEVEN BANKS IN SHANGHAI.

Trade depends upon finance for its vitality, but it is to the banks that we look for the efficient handling of finance, says the "North-China Daily News." Shanghai, being the central emporium of commerce in this country, holds a position that may financially be likened to that held by New York in America, though not of the same magnitude, of course. Therefore, the banking business here has developed to a remarkable extent, in fact, it has enjoyed unprecedented prosperity for several years past, until now Shanghai stands easily at the head of all the towns and ports in this respect.

At first, foreigners were predominant among those doing banking business, but latterly Chinese merchants have been attracted to embrace the modern system of working a bank. The majority of the latter have, however, come to grief, owing more or less to incompetency and want of experience. Only in very recent years have modern banks promoted and operated by Chinese gradually been enabled to hold their ground.

At present, there are 18 foreign banks, 18 Chinese banks, four Chinese-foreign coöperated banks, 7 newly-opened and 10 in course of promotion, or 57 in all. All Chinese banks run on the old, orthodox lines handed down from ancient times, are not included in the above category.

PRODUCTION TOPICS

INCREASE IN INGOT TONNAGE FOR MAY.

The statistics of steel ingot production in the United States in May, just published by the American Iron and Steel Institute, show an increase of nearly 10 per cent over the output in April, which in turn was 16 per cent less than that of March. The figures furnished by 30 companies which made about 84 per cent of the country's steel ingot production in 1918 gave a total of 2,883,164 gross tons for May against 2,638,305 tons in April. Counting 26 working days, the May total represents 110,891 tons per day for the 84 per cent. If the remaining 16 per cent produced at a corresponding rate, the total output of the country in May was 3,431,113 tons, or 131,966 tons per day.

The figures below from the monthly report of the American Iron and Steel Institute show the distribution as between Bessemer and open-hearth steel ingots. Statistics were not gathered in September, 1919, the first month of the steel strike or in the three months following.

Monthly Production of Steel Ingots of Companies Producing 84.03 Per Cent of Total in 1918—Gross Tons.

	Open hearth	Bessemer	All other	Total
January, 1919 ...	2,351,153	749,346	7,279	3,107,778
February	2,043,635	655,206	5,842	2,704,683
March	2,100,528	555,332	6,405	2,662,265
April	1,732,447	500,770	6,494	2,239,711
May	1,506,015	414,392	8,617	1,929,024
June	1,692,257	521,634	5,328	2,219,219
July	1,875,630	625,246	7,300	2,508,176
August	1,988,651	748,212	9,218	2,746,081
January, 1920 ...	2,242,758	714,657	10,687	2,968,102
February	2,152,106	700,151	12,867	2,865,124
March	2,487,245	795,164	16,640	3,299 049
April	2,056,336	568,952	13,017	2,638,305
May	2,251,544	615,932	15,688	2,883,164

The ingot production of the 30 companies reporting was 14,653,744 gross tons in the first five months of the year. This represents for all the steel companies of the country an annual rate of approximately 41,400,000 tons of ingots, which is surprisingly large in view of all the handicaps of the year.

THE IRON ORE MOVEMENT.

The movement of iron ore from the Lake Superior district has not been very brisk to date this year, the reason being that there is a car shortage in the East and it is impossible to move ore from the lower docks to the furnaces at a rapid rate. There is considerable ore in stock at the Lake Erie docks and some vessels have to remain there for five and six days before being unloaded. There will not be much change in the dock situation until the roads can take ore for direct shipment much faster than they are able to handle it at present.

Coal is moving slowly from the mines in Pennsylvania and West Virginia to the Erie docks which is the reason that very little coal is being transported up the lakes. The shippers, who decided last month to pool, have completed arrangement for pooling the lake coal on the 1918 basis, and a start has already been made. The business will be handled by the ore and coal exchange and the pool numbers will be the same as in 1918. This means that the number of consignments will be cut down and that the coal will move much faster after it reaches the Erie lake front, but the mines will have to get a much better supply of cars or the movement for the season will not reach the 1919 total, which was the lowest for a number of years.

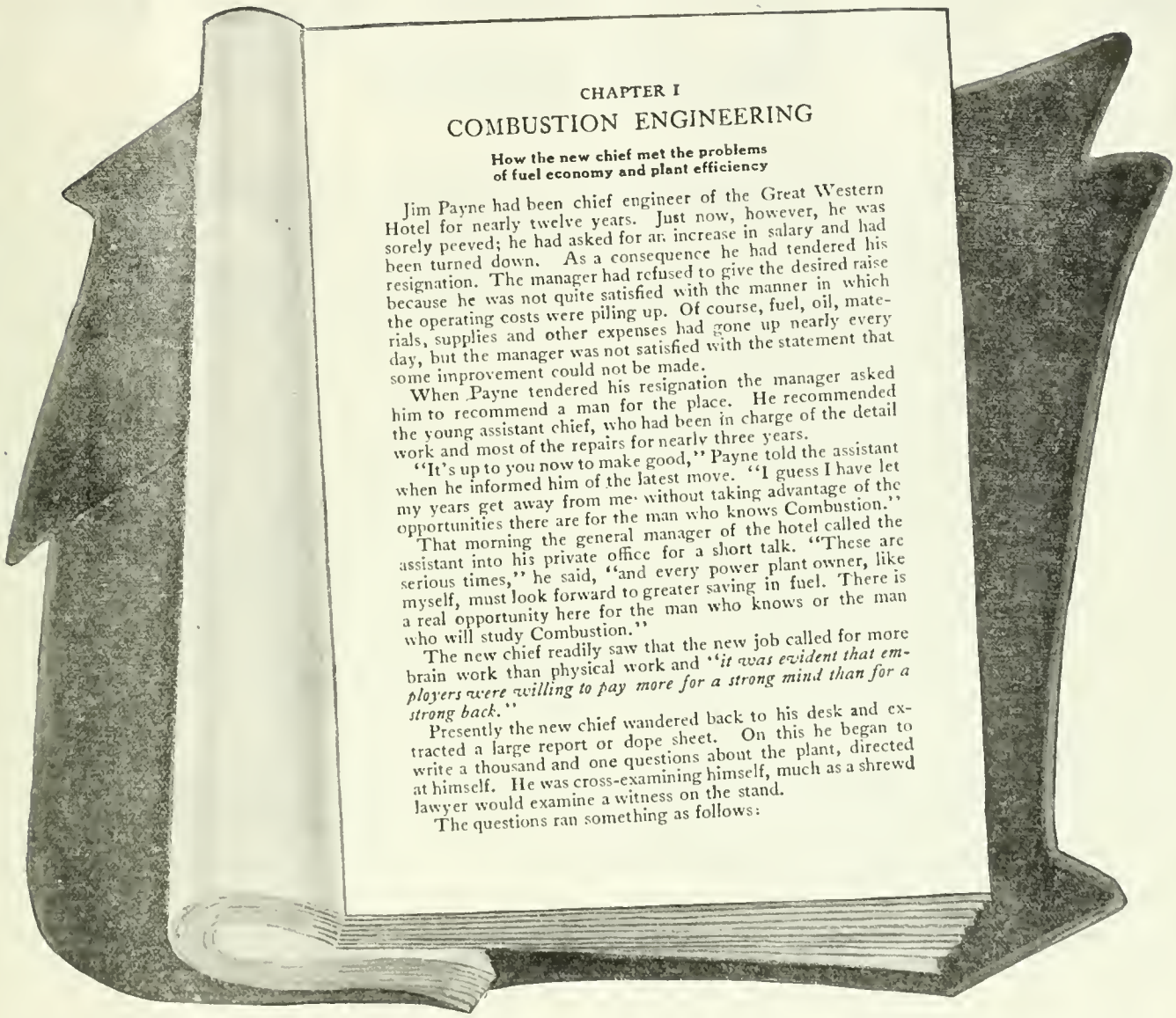
TONNAGE OUTPUT OF STEEL INDUSTRY.

It is a good motto, and a useful one, that "obstacles were made to be overcome." The steel industry is now showing, in its tonnage outputs, the results of having learned fresh lessons during the war in overcoming obstacles. It is not long ago that what appeared to be a gloomy view of the future tonnage output of the industry was being taken by some classes of officials in steel companies, particularly in sales departments, but the actual tonnage outputs being made indicate that the steel industry is already on a fair road toward functioning better than ever, and producing a total output larger than it had been supposed capable of producing even under favorable physical conditions. The steel industry has been a leader in many respects, illustrating what can be accomplished by courage in adopting heavy machinery and trying new devices and methods. With the world at large, including the United States, suffering economically from inefficiency and what amounts to laziness, the steel industry of the United States will help the world if it sets an example now of producing steel at a greater rate than it had been assumed capable of judging by past performances. By taking account of production in past periods of activity and allowing for new construction meanwhile, the steel ingot-producing capacity has been estimated in recent months at not over about 50,000,000 tons per annum, but it seems quite probable that in the near future a rate of output nearer 55,000,000 tons will actually be shown —Chemical and Metallurgical Engineering.

SCRAP HELPS STEEL OUTPUT.

At first glance steel production in May was surprisingly large considering the prevailing conditions and, according to the statistics just announced, was at the rate of approximately 42,270,000 tons of ingots annually. With castings added, the total steel production in May was not far from an annual scale of 43,500,000 tons. This shows a margin of about 6,500,000 tons or 17.5 per cent over the rate of pig iron in May which, including an estimate on charcoal iron, was on the basis of approximately 37,000,000 tons yearly. Yet it is apparent that the relation between steel and pig iron outputs at present is in line with the recent trend of production.

During the past few years, or since 1910 when steel production of the country for the first time passed that of pig iron, the spread between the total output of the steel works and the blast furnaces has ranged from a fraction of 1 per cent to 16.64 per cent in favor of the former. In 1911 the production of these two branches of the industry were practically on a parity; in 1912 steel exceeded pig iron by 5.12 per cent; in 1913 by 1.08 per cent; in 1914 by a fraction of 1 per cent; in 1915 by 7.47 per cent; in 1916 by 8.45 per cent; in 1917 by 16.64 per cent; and in 1918 by 13.86 per cent. The official 1919 figures have not been made public. It is to be noted that the spread of steel and pig iron has been steadily growing though by an irregular curve, due to the constant expansion of the open hearth process with its consequent consumption of scrap.—Iron Trade Review.



CHAPTER I

COMBUSTION ENGINEERING

How the new chief met the problems of fuel economy and plant efficiency

Jim Payne had been chief engineer of the Great Western Hotel for nearly twelve years. Just now, however, he was sorely peeved; he had asked for an increase in salary and had been turned down. As a consequence he had tendered his resignation. The manager had refused to give the desired raise because he was not quite satisfied with the manner in which the operating costs were piling up. Of course, fuel, oil, materials, supplies and other expenses had gone up nearly every day, but the manager was not satisfied with the statement that some improvement could not be made.

When Payne tendered his resignation the manager asked him to recommend a man for the place. He recommended the young assistant chief, who had been in charge of the detail work and most of the repairs for nearly three years.

"It's up to you now to make good," Payne told the assistant when he informed him of the latest move. "I guess I have let my years get away from me without taking advantage of the opportunities there are for the man who knows Combustion."

That morning the general manager of the hotel called the assistant into his private office for a short talk. "These are serious times," he said, "and every power plant owner, like myself, must look forward to greater saving in fuel. There is a real opportunity here for the man who knows or the man who will study Combustion."

The new chief readily saw that the new job called for more brain work than physical work and "*it was evident that employers were willing to pay more for a strong mind than for a strong back.*"

Presently the new chief wandered back to his desk and extracted a large report or dope sheet. On this he began to write a thousand and one questions about the plant, directed at himself. He was cross-examining himself, much as a shrewd lawyer would examine a witness on the stand.

The questions ran something as follows:

WHAT are your chances for real success?

Do you realize the opportunities that a knowledge of Combustion offers to the man who wants to be more than merely the average?

It is not so much a strong back today as it is a strong mind that counts!

The man who knows Combustion can state his own salary and his services are always in demand.

Would you like to have the opportunity of getting a thorough knowledge of Combustion and Boiler Room Management in your spare time and at a very small cost, payable monthly if so desired? Jos. W. Hays, author of the Course and Educational Director, formerly Consulting Combustion Engineer of the U. S. Navy; W. L. Abbott, Chief Operating Engineer of the Commonwealth Edison Company; Fred R. Low, Editor of "Power"; Prof. S. W. Parr, Department of Chemistry, University of Illinois; Joseph Harrington, formerly Administrative Engineer, U. S. Fuel Administration; David Moffat Myers, formerly Advisory Engineer for the U. S. Fuel Administration; Arthur L. Rice, Editor of "Power Plant Engineering," and I. E. Moultrop, Bureau of Construction, Edison Electric Illuminating Co., have now made it possible for you, thru the Hays Course in Combustion Engineering and Boiler Room Management, to obtain a thoro knowledge of Combustion in your spare time without intetfering with your present work in the least.

This Free Book

will tell you some interesting pointers that the average power plant and boiler room man should know, particularly about Combustion Engineering

The coupon will bring to you, without any expense whatever, a copy of this interesting book, covering power plant and boiler room management. It rells you how other men like yourself have, thru the Hays Course, achieved real success and how the same can be made possible in your case.

If you are determined to get out of the ordinary class and to push ahead where your services will be worth much more than they are today, get your copy of this book at once. It will help you from the time you receive it. It will interest and inspire you because it shows a better way toward bigger things. It also shows how, thru the Course, in addition to obtaining a knowledge of Combustion, you get, as well, a liberal education, paving the way for real executive ability.

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A Few weeks ago we were discussing the subject of bearing metals with the Chief Engineer of a well known Corporation. In the course of the conversation we asked him the above question, and received the answer that would be given by nine hundred and ninety-nine of every thousand engineers.

We told him the following story, gave him a copy of "The Restoration of a Lost Art," and went our way.

Here is the story:

> *At a meeting of the Committee appointed to prepare the new Dictionary of the French language, one of the members was asked to define the word "Lobster". He replied "The lobster is a fish, red in color."*
>
> *The Chairman immediately retorted: "My learned friend is right except in two unimportant details. A lobster is not red, neither is it a fish."*

The next morning the Chief Engineer called us up and said: "I have read your book and guess I was the Frenchman. Send me a thousand pounds of your metal."

How much do *you* really know about Bearing Metals?

The coupon brings your copy of "The Restoration of a Lost Art."

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Also send me information regarding the use of PROMET in _____
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PRODUCTION TOPICS

INTERSTATE COMMERCE COMMISSION'S

The Interstate Commerce Commission dropped a bombshell into the iron trade recently by prohibiting the use of open top cars except for the coal trade. The coal situation is desperate, but the remedy proposed is a good deal worse than the disease. Modern iron furnaces receive their ore, their coke and their limestone in open top cars. There is not any way of loading these raw materials except in open top cars. Pig iron is loaded direct from the casting machine or by magnets, and open top cars are the only equipment that can be used.

WORLD LOOKS TO UNITED STATES FOR STEEL.

Upon the United States rests the responsibility of making up the tremendous world-wide shortage of iron and steel caused by the war, says Herbert P. Howell, vice president of the National Bank of Commerce, in New York, in an article on "The International Market for Iron and Steel," which appears in the July issue of "Commerce Monthly," that bank's magazine of commerce and finance.

Mr. Howell points out that the vast quantities of iron and steel used in the making of war munitions have left the world with a four years' accumulation of needs for such metals for industrial uses. Great Britain alone of the European producing countries today is capable of competition with this country in supplying this demand.

"The world is short of iron and steel," Mr. Howell says. "The United States, Great Britain and Germany produce 80 per cent or more of the total iron and steel output of the world, while Belgium is a considerable factor in the international market. The war had varying effects on the industries of these three European countries. The case of Germany is clear. As a producer of iron and steel for the international market, that country need not be reckoned with at present. French production is dependent on German coal, and lack of fuel and industrial disorganization have thus far kept it much below the pre-war level. The Belgian industry shows encouraging features and exports are increasing, but domestic demand is heavy and the amount Belgium can export will not greatly affect the international market in the immediate future.

British Position Improving.

"The only active competitors of the American iron and steel producers at the present time are the iron-makers of the United Kingdom. Steel output in the United Kingdom during the first five months of 1920, although at a lower rate than in 1917, was above the rate for any other year. Exports of iron and steel must still increase before they reach the rate maintained in 1913. Remarkable increases over exports for 1919 are shown by the British figures for the first four months of 1920. Gains were made in all the items except six, the gain for the different classes of products ranging from 8 per cent to over 400 per cent. The British position is improving and must not be underrated.

1919 Recession a Calamity.

"The arrears caused by four years' destruction of steel and by reduced output after the armistice cannot be made up in the near future by any country except the United States. Yet in the first calendar year after the war American pig iron output dropped to 31,015,000 tons, which was 8,000,000 tons below that of 1918 and practically the level of 1913. The fact that this reduction occurred without financial or industrial disturbance is a matter for congratulation, but in view of the five years' accumulated need of steel throughout the world it is a calamity. The first three months of 1920 showed an expanding rate of production, but the railroad strike brought about a serious reduction, so that the April output of pig iron dropped to 2,740,000 tons. The total for the first five months of 1920 was 15,000,000 tons. In spite of fluctuations, production in the United States is being maintained at a rate more than double the present output of Germany and the United Kingdom combined.

"Despite unfavorable exchange, Canada must buy American sheets and plates to keep the wheels turning in her own industries. The United Kingdom received much larger quantities of steel ingots and billets from the United States in March, 1920, than during the corresponding month of 1919. Steel for ship-building was exported to France in April of this year in spite of exchange difficulties, and shipments of steel plates to Italy in March exceeded those made in March, 1919. It is to be expected that foreign customers will restrict their purchasing at times in response to disadvantageous exchange conditions, but in such periods the shortage grows and must eventually be met.

"Even assuming a production of pig iron in 1920 equal to that of the best war year, and a rate of export somewhat higher than that of the pre-war years, the exportable surplus of the United States is not likely to equal Germany's annual exports in the years immediately preceding 1914. The United Kingdom is unable at present to recover her former volume of exports except at a sacrifice of domestic needs. There can be no question, therefore, as to sufficient foreign outlets for all the United States can spare and more. The American iron and steel industry has the resources, the capacity and the industrial organization to produce largely beyond domestic needs. A responsibility rests upon this country to maintain production at a point where the industry can do its share toward satisfying the world-wide need of steel."

FRENCH OUTPUT INCREASING.

With improvement not only in the labor situation but also in coal and coke, the outlook in iron and steel at the beginning of June seems much better. Relations between employers and employes have not been entirely settled, notably at Hagondange, nevertheless this is now only a matter of detail. The recent strikes have permitted accumulation of coke, and a number of blast furnaces have now been put into operation, including four at Hagondange, five at Rombas-Maizieres and four at Knutange. Production on the whole has never been as much since the armistice.

Further increases in the capital stock of various companies are announced. The latest was Acieries et Forges de Firminy, whose stockholders voted to double the present capital of 20,000,000 francs. At the stockholders' meeting it was stated that the principal Firminy plant is operating at full capacity with 5,000 men, and that the Dunes plant will be doing likewise next year. The business being done was stated to be 10,000,000 francs a month.

At the forthcoming meeting of the Ateliers de Construction du Nord de la France the proposal will be considered of absorbing the Societe de Blanc Misseron, which is a builder of locomotives. During 1912 and 1913 the company turned out 27 locomotives. It hopes now to build regularly 80 to 90 locomotives each year.

Klaus Sollie, who has been chief draftsman for the Youngstown Sheet & Tube Co. for the past three years, has been appointed chief engineer of that company succeeding William Forsstrom who has resigned from that position to accept one in a similar capacity with the Wisconsin Steel Company, on July 1.

V V

At the annual meeting of the Bridgeport Rolling Mills, Inc., Bridgeport, Conn., the following officers were elected: President, William R. Bull; vice president and works manager, George D. Stearns; secretary and treasurer, Anton C. Raffauf.

V V

Alois Hauser, who has been efficiency engineer at the Saucon plant of the Bethlehem Steel Company, has been appointed assistant to the works manager of the Timken Roller Bearing Company, Canton, O.

V V

A. F. Stirling Blackwood, formerly of the Union Steel Casting Company, has resigned from that company and will organize a new company to make steel castings by a new process of melting.

V V

Walter B. Enck has assumed his new duties as vice president of the International Fuel & Iron Company, at Philadelphia. Mr. Enck was formerly vice president of the Donner Steel Company, Inc., Buffalo.

V V

John S. Crowther, Jr., has been appointed general superintendent of the Toledo Furnace Company, Toledo, O., succeeding Elton H. Hull, who has resigned to become manager of the blast furnace department of the Pickands, Mather & Company, at Cleveland, O.

V V

G. A. Orr has resigned his position as assistant to the president and general manager in charge of operations of the Central Iron & Steel Company, Harrisburg, Pa., to accept the vice presidency in charge of operations of the Cromwell Steel Company, Lorain, O.

V V

Arthur E. Kent has resigned as chief engineer of the Pittsburgh Crucible Steel Company, Pittsburgh, Pa.

William T. Lewis has been appointed superintendent of the Liberty works of the Trumbull Steel Company, Warren, O. Mr. Lewis was formerly hot mill foreman of the Farrell, Pa., plant of the American Sheet & Tin Plate Co.

V V

Robert H. Watson, formerly general superintendent of the Detroit Iron & Steel Co. plant has been appointed blast furnace superintendent of the Ford Motor Company's new plant at River Rouge, Michigan.

V V

Edward F. Merrill has been appointed general manager of the Dominion Iron & Steel Company. Mr. Merrill's headquarters will be in Sydney, O., and he will have charge of all operations of that company.

V V

Eugene Dowling has been appointed general manager of the steel industry department of the H. W. Johns-Manville Company, New York.

V V

G. W. Price has been appointed superintendent of the Anniston Steel Company, Anniston, Alabama.

V V

George P. Speer has been appointed general manager of the Corbin Screw Corporation, New Britain, Conn.

V V

V. B. Chamberlain, who has been superintendent of several departments of the Stanley Works, New Britain, Conn., has been made manager of sales and production.

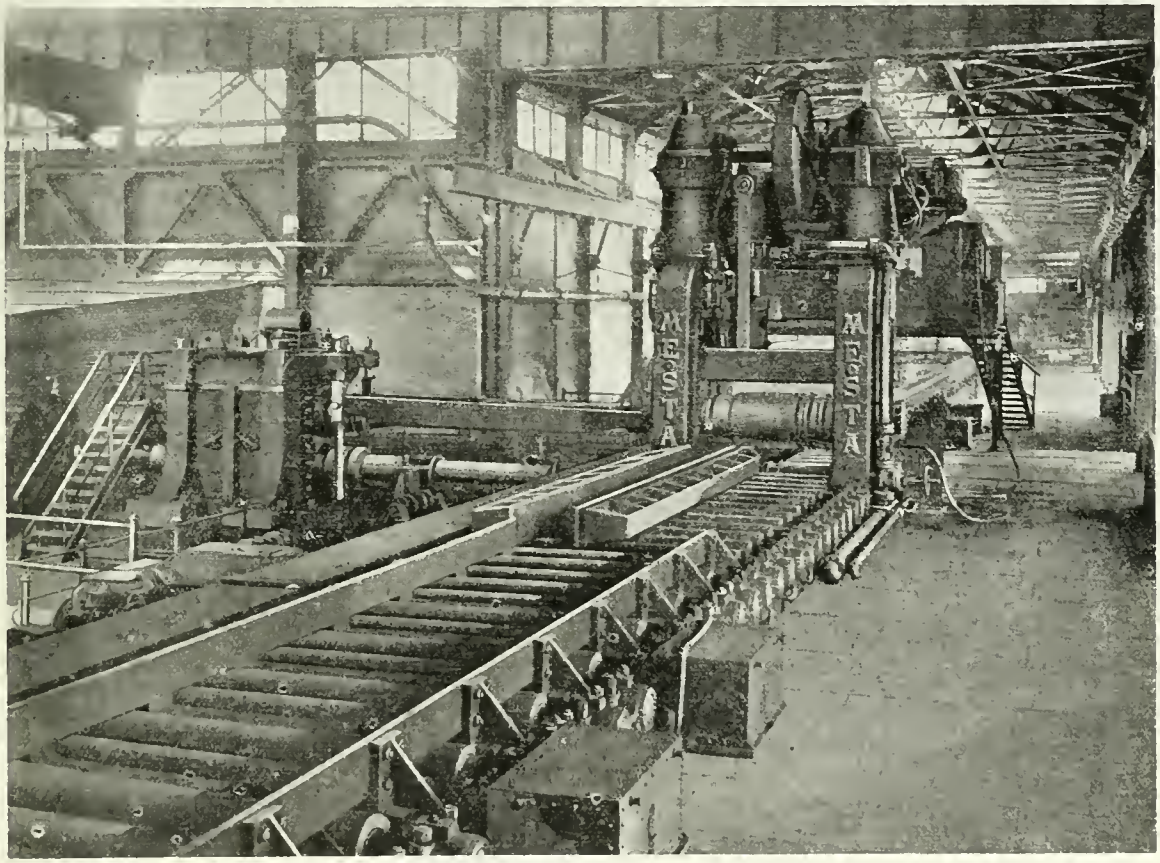
V V

Col. E. H. Williams has recently become identified with the Valley Mold & Iron Corporation, Sharpsville, Pa., as manager of service and inspection departments, with which will be connected considerable research work. Colonel Williams recently resigned from the army, his last duties having been as a member of the general staff at Washington. He entered the army as a private about two and a half years ago and was one of two civilians to attain this unusual honor.

V V

The following changes have been made in the different departments of the Crucible Steel Company of America: John A. Sutton, vice president, and George W. Sargent, metallurgist, have retired. W. D. Wintersmith, assistant

MESTA BLOOMING-MILLS



40" Mesta Blooming Mill Installation

Designed and Built for Maximum Production

A DELAY in the operation of the Blooming Mill not only means a decrease in production and increase in cost of material being rolled; but very often causes delays and added expense in other departments that are dependent upon the Blooming Mill for material.

Mesta Patented Universal Spindles and Couplings, with Spindle Shifting Device which permit quick roll change; quick acting Screw Down; Forged Steel Spindles and many other distinctive features with respect to design and material used, **insure continuous operation to the greatest possible extent and practically eliminate the possibility of any serious delay.**

MESTA MACHINE COMPANY
PITTSBURGH PENNSYLVANIA

1886 1920

ASHLAND
FIRE BRICK

Has long been serving the steel industry in its varied operations.

Metallurgists who made their first Ashland installation are still using Ashland Fire Brick. Superintendents who have tried Ashland with other brick invariably specify them.

—WHY"

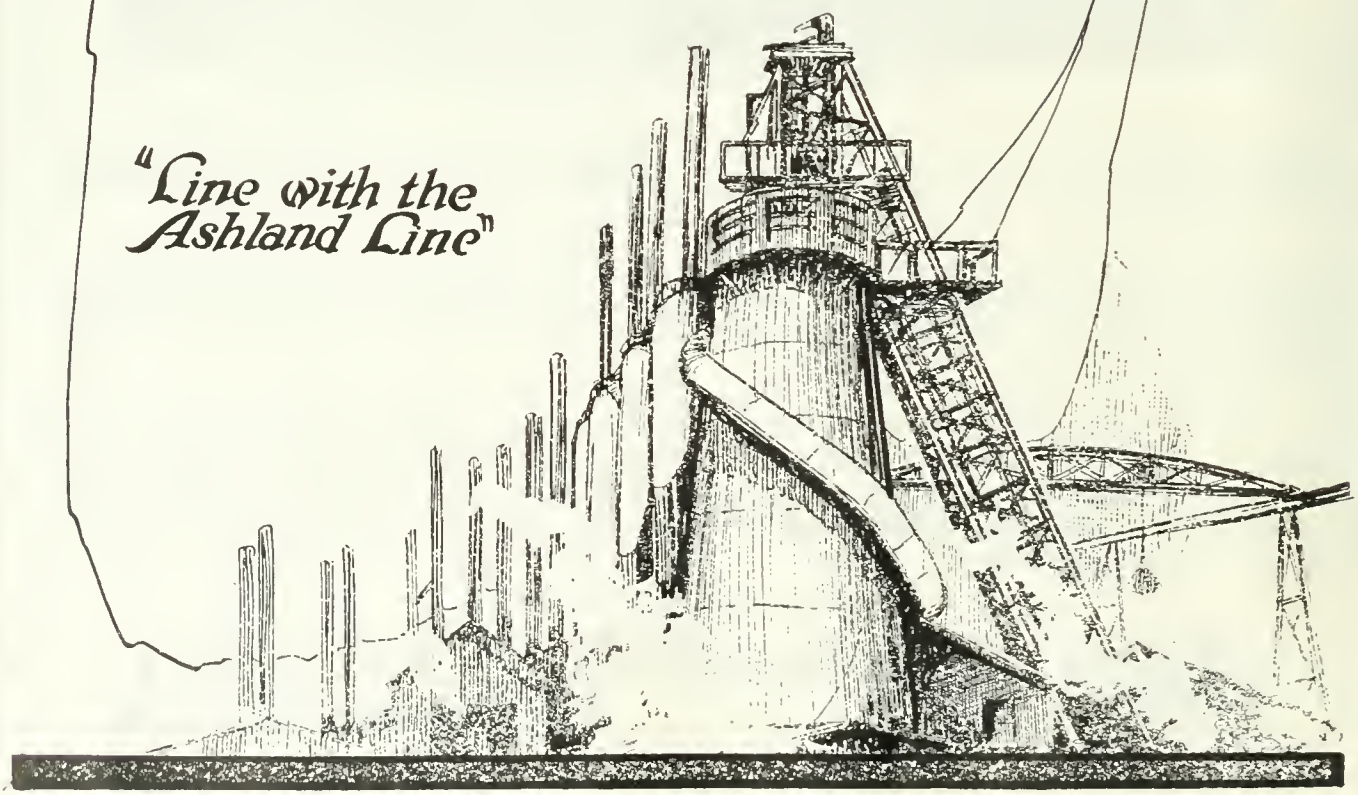
Ashland Fire Brick is uniform, is pure and has great durability. Many replacements which were constantly occuring in furnaces lined with poor fire brick have been eliminated with the employment of Ashland Fire Brick. This has been accomplished through the efforts of an organization thoroughly familiar with the fire brick "game." Ashland Fire Brick means more than good fire brick. It extends to the installation and the actual results in practice. It is the Ashland purpose to supply you, not with fire brick, but with the means of long continuous uninterrupted production.

Many large plants now co-operating with the Ashland Organization are getting longer life and greater tonnage from their linings.

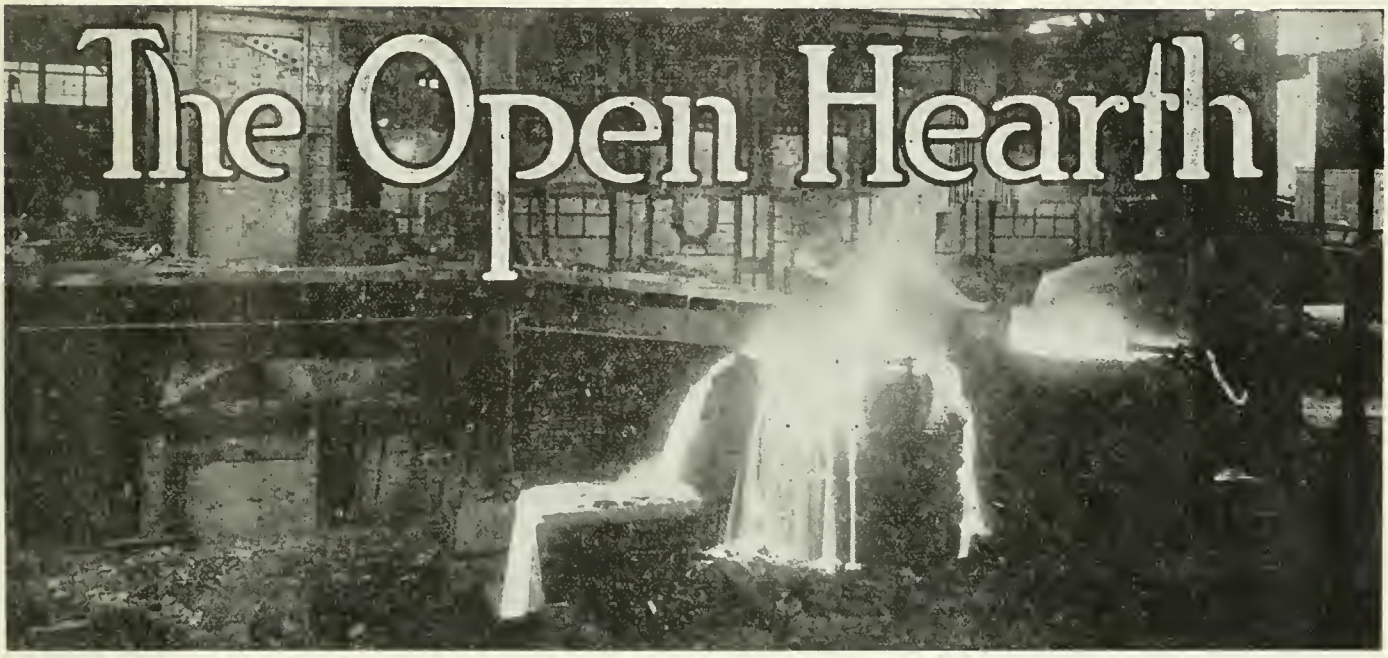
Ashland Fire Brick Co.

ASHLAND, KY. *Incorporated 1886*

"Line with the Ashland Line"



Co-operate:—Refer to The Blast Furnace and Steel Plant



general sales agent has been appointed superintendent of agencies. D. C. Barry has been appointed comptroller of the company.

V V

E. L. Larson, formerly of the Detroit Pressed Steel Company, has been appointed works manager of the Locomobile Company, Bridgeport, Conn.

V V

John D. Caldwell has been appointed district manager of sales for the Brier Hill Steel Company, Youngstown, O., in Chicago, succeeding to the position vacated by the death of Joseph A. Rees.

V V

G. E. Swartz has resigned from the Torbensen Axle Company, Cleveland, to become manufacturing manager of the Timkin-Detroit Axle Company.

V V

W. C. Buell, Jr., formerly engineer of tests and later chief engineer of Tate-Jones & Company, Inc., on June 1 became associated with the George J. Hagan Company, Pittsburgh, furnace and combustion engineers, as chief engineer of their newly organized liquid fuel department.

V V

Elbelt Rogers has been appointed purchasing agent for the Wickwire-Spencer Steel Corporation, Buffalo, to succeed Albert C. Lorion, resigned.

V V

Judge Gary expects to sail for Europe next month. This will be Judge Gary's first trip to Europe since 1914, or previous to the war.

V V

A. M. Menefee was recently appointed superintendent of the Replogle Division of the Wharton Steel Company.

V V

Craig Adair has been elected president and vice president and treasurer, respectively, of the Adair-Day Corporation, Philadelphia, Pa. Mr. Adair was formerly vice president of the Penn Seaboard Steel Company, Philadelphia.

V V

Joseph P. Catlin, for the past nine years engineer of the motor department of the Pittsfield, Mass., works of the General Electric Company, has been appointed chief engineer of the new Bridgeport, Conn., works of the company, and assumed charge June 1. Carl M. Lynge, of the Pittsfield works, is to be assistant engineer under Mr. Catlin, and F. J. Pilon, in charge of costs in the motor department of the Pittsfield works, has been appointed in charge of the entire cost department of the Bridgeport works.

V V

W. F. Myer has been appointed directing transmission engineer of the industrial bearings division of the Hyatt Roller Bearing Company, New York.

V V

Thomas A. Lincoln has been made foreman of the heating-treatment department of the New Departure Manufacturing Company, Bristol, Conn.

V V

Sidney Hughes has been appointed assistant works manager of the Gilbert & Barker Manufacturing Company, Springfield, Mass.

V V

A. Cohen, recently representative for the Carnick Brothers Company, Youngstown, O., in their Pittsburgh office, has been appointed manager of the Keystone Steel Company, a new Pittsburgh Company.

V V

George Dutney has resigned his position as superintendent of No. 12 mill, South Side plant of Jones & Laughlin Steel Co., to accept a position with Johns Manville Company.

V V

Commander R. D. Gatewood, of the Construction Corps, United States Navy, has been selected by Chairman Benson as director of construction and repair of the Emergency Fleet Corporation, relieving R. L. Hague, of San Francisco. Commander Gatewood was graduated from the Naval Academy in 1903 and from the post graduate course of naval architecture and marine engineering at Massachusetts Institute of Technology in 1906. He has been in charge of repairs and new construction on both the Atlantic and Pacific coasts and for two and one-half years was fleet constructor of the North Atlantic fleet. During the war he was superintendent of motive power for the Panama railroad in charge of the large shops and drydocks at both ends of the Isthmus and made an enviable record in connection with extensive repair and refitting work on merchant vessels. Commander Gatewood's main office will be in Washington. His New York office will be at 45 Broadway.

NEWS OF THE PLANTS

The Electric Alloy Steel Company, Youngstown, O., is planning for the early operation of its new plant at Charleroi, Pa., recently acquired. The plant comprises the former works built by the government at this place, devoted to the production of plates for eagle-boats and kindred products. It was purchased from the Universal Steel Company. The property comprises about 13 acres of land, with a number of buildings. The main structure is 57x530 feet, while two adjacent buildings are of a size 90x525 feet, and 90x227 feet, respectively. There are also a number of smaller structures. The new owner is making improvements at the plant and getting facilities arranged to insure continuous operation. The equipment will consist of a six-ton electric furnace, and two crucible furnaces. Plans are also being considered for the erection of a new plant in Trumbull county, but actual construction may be delayed for a few months, awaiting the return of more normal building conditions.

The National Steel Rolling Company, 295 Passaic street, Newark, N. J., has taken bids for considerable equipment for its proposed new plant in the Lansdowne district, Baltimore, Md. It is planned to inaugurate construction at an early date on the first unit of the new works, to consist of a main one-story building, 70x140 feet, estimated to cost close to $100,000, including machinery. This equipment will consist of rolling mill machinery, forge shop equipment, machine tools, electric apparatus, etc. The plant will specialize in the manufacture of bar iron and steel and has been designed for an initial output of about 25 tons of material per day. The company has established local offices in the Keyser Building.

The La Salle Iron Works, 2305 South Halsted street, Chicago, Ill., has taken bids for the erection of a new plant at West Hammond, Ind. The initial works will comprise a main one-story building, 180x220 feet, to be equipped for general iron working. The plant is estimated to cost about $250,000, including machinery.

The Newton Steel Company, Newton Falls, O., is conducting active operations at its recently established plant in this district, devoting production to high grade steel sheets, used for automobile body construction and kindred service. The plant consists of eight stands each of roughing and finishing mills, and has facilities for an annual capacity of about 50,000 tons of material. The company has a site totaling 150 acres along the Mahoning River, giving sufficient ground for expansion as may be required. Arrangements have been perfected to use powdered coal, and fuel of this character is now employed for boiler service, as well as for the sheet, pair and annealing furnaces. The company is operating with a capital of $3,000,000. Edward F. Clark is president.

Extensive operations are under way at three of the iron mills at Columbia, Pa. The Columbia Rolling Mill and the Susquehanna Rolling Mill, recently acquired by the Reading Iron Company, Reading, Pa., have been remodeled and improved and operations inaugurated. The first noted plant will give employment to about 350 men and the other, 250 men. The Superior Sheet & Tube Company, Youngstown, O., is arranging for the early operation of a former pipe mill acquired at Columbia. This plant has been idle for some time past; it has been improved and brought up-to-date by the new owner, and will give employment to about 500 men when operating full.

The American Furnace & Foundry Co., Milan, Mich., is planning for the erection of an addition to its plant for increased production. The proposed structure will be one story, 80x250 feet, and will be used for the production of furnaces, furnace castings, etc. It is estimated to cost about $150,000, including equipment. E. S. Watson is president.

The Illinois Malleable Iron Works, 1825 Diversey Parkway, Chicago, Ill., has plans under way for the erection of a new plant in the vicinity of Louisville, Ky. The proposed works will comprise two main buildings for foundry operations, annealing and general production, of a size 147x243 feet, and 113x185 feet, respectively. It is planned to develop an annual capacity in excess of 6,000 tons.

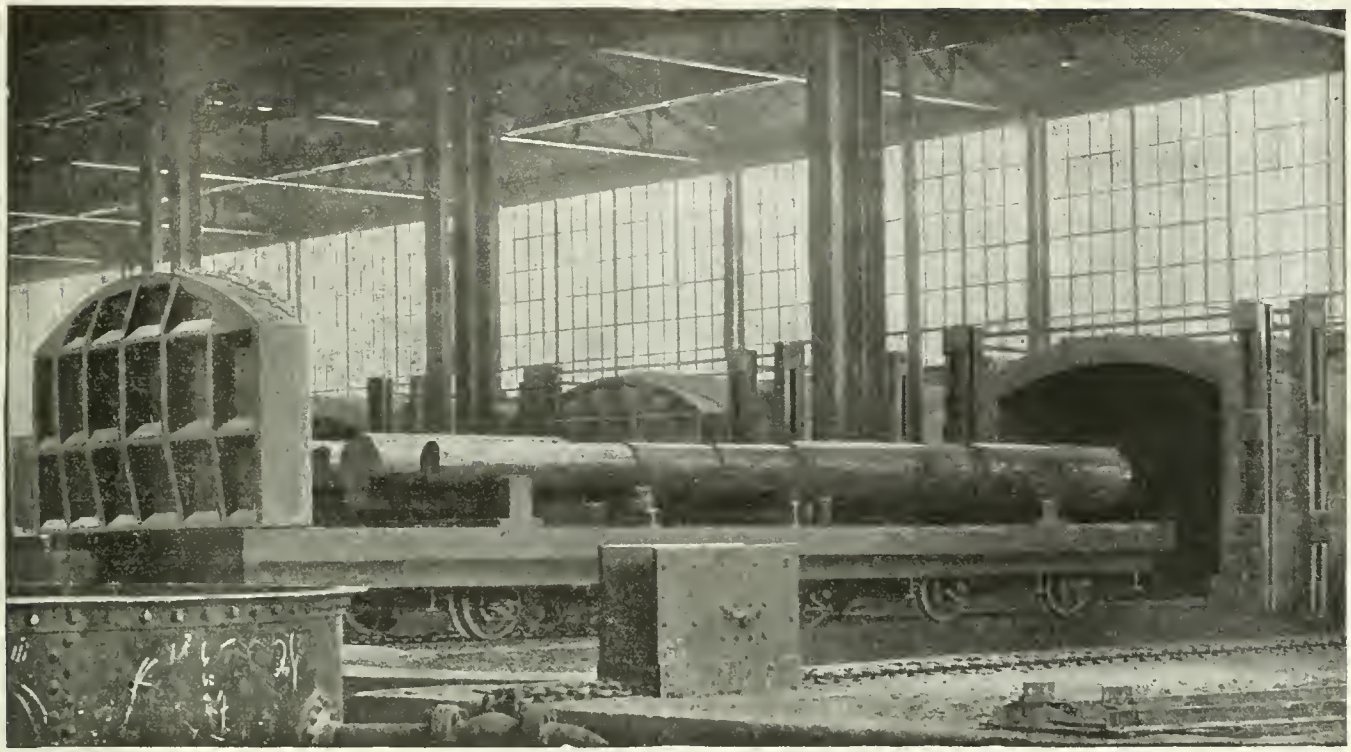
The Dominion Steel Corporation, Sydney, Nova Scotia, has inaugurated operations at its new local mill, which has been in course of erection for many months past. The plant represents an investment of about $5,000,000 and will be used primarily for the manufacture of ship plates. The designed capacity totals about 12,000 tons a month, and a large portion of the output will be taken by the Government. The product includes plates of iron from 3/16 inches to 2¼ inch gauge, up to widths of 98 inches, and lengths up to 80 feet. It is proposed to maintain active production at the plant with maximum output.

The Trumbull Steel Company, Warren, O., is planning for the erection of a by-product coke works in connection with the new blast furnace now being built in coöperation with the Cleveland-Cliffs Iron Company, through the Cleveland-Cliffs Furnace Company. The new blast furnace will have a capacity of about 600 tons, and it is proposed to push construction to completion. The Trumbull Steel Company has recently increased its capital from $14,000,000 to $25,000,000 for expansion, etc.

The Interstate Iron & Steel Co., 104 South Michigan avenue, Chicago, Ill., has perfected plans for the erection of a new plant at One Hundred and Eighteenth street and the Calumet River. The plant will be used as a merchant steel mill; it will be 100x900 feet, and is estimated to cost in excess of $300,000, including machinery. The Great Lakes Dredge & Dock Company, Chicago, has the building contract.

The Cambridge Steel Company, Cambridge, O., has commenced the erection of a new plant on the site of the former Cambridge rolling mill, which was destroyed by fire some time ago. The new plant will be used as a re-rolling mill for the manufacture of steel bars and other specialties from old rails. It will include a main building, 125x350 feet, with installation consisting of a 14-inch and 16-inch bar mill, with auxiliary manufacturing and operating equipment. T. W. Scott is president of the company, having acted in like capacity with the Cambridge Rolling Mill Company.

The Kentucky Steel Products Company, Lexington, Ky., recently incorporated, has arranged for the erection of a new plant on local site to cost about $250,000, including equipment. An important feature of production will be steel wire nails, and it



EASTON CARS Made for *Your* Work

OUR business is to make you ***the*** car you want, and not necessarily to sell you ***a*** car we've made. Of course, we have stock models of industrial cars for various industries, but at that, they represent the consensus of car needs in these industries, rather than an arbitrary design. The skill of our engineers is backed by a manufacturing experience of more than a quarter of a century.

Whatever your plant needs to carry on wheels, we can plan the routing, make and lay the track and build the cars that will do the work most economically and efficiently. That is what we mean by Easton Industrial Service.

Tell us your needs and wishes and we will be pleased to make recommendations.

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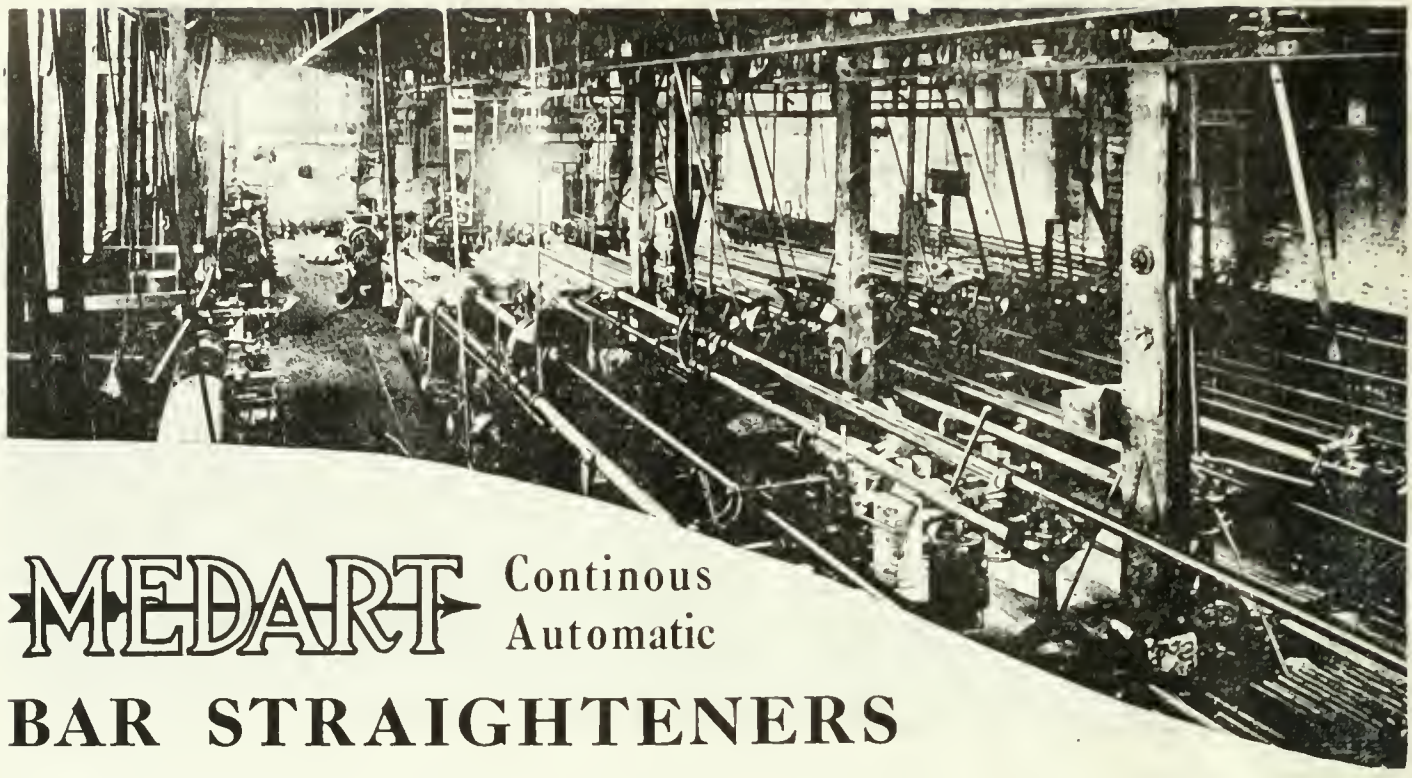


MEDART Continous Automatic BAR STRAIGHTENERS

Are shown in the above plant where many tons of bars are straightened daily. Here as in many other plants the Medart is employed in straightening bar products for many uses.

Any length bar can be handled on this machine and from 40 to 80 feet per minute can be straightened, polished and cold rolled in the one operation.

Size of bars handled range from 1/16" to 6" in diameter. One man and a helper can operate six machines properly and the cost of turning is reduced to a low figure.

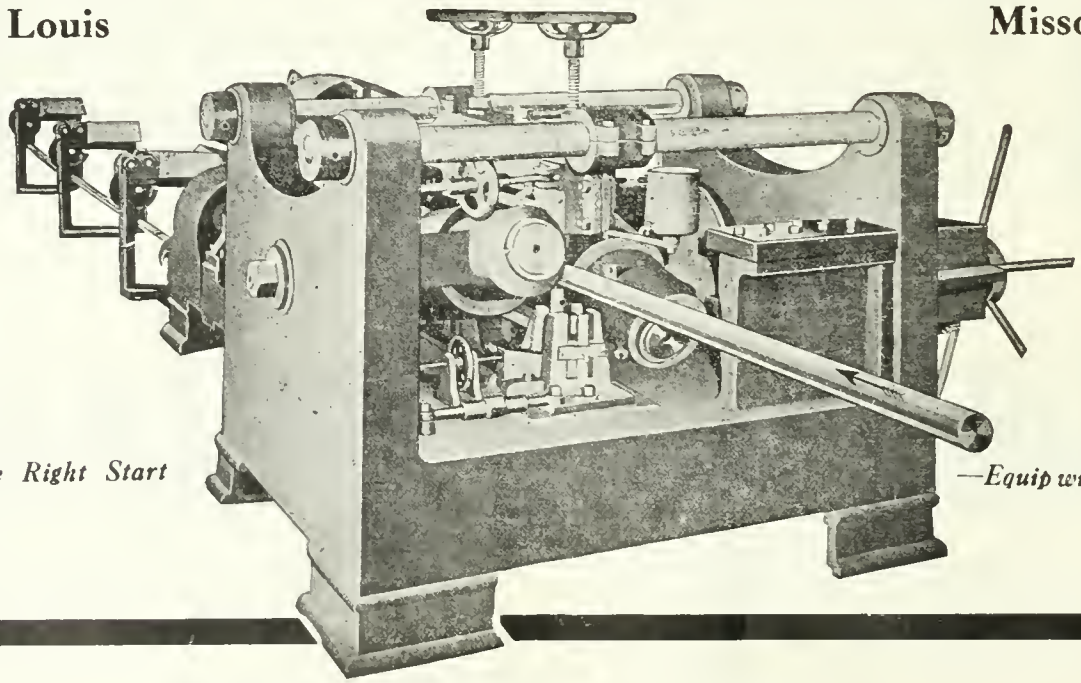
In these days when help is scarce, particularly mechanics, this feature is of first importance.

The Medart Straightener is automatic in operation with worm gear drive giving positive operation. All grades of metal can be handled with equal success, from soft brass to alloy steel.

Write for Medart Literature.

Medart Patent Pulley Company

St. Louis **Missouri**



"To get the Right Start —Equip with MEDART"

Co-operate:—Refer to The Blast Furnace and Steel Plant

NEWS OF THE PLANTS

is planned to develop a capacity of about 25 tons a day of material of this character. The machinery installation is estimated to cost about $150,000. James C. Stone and John R. Humphrey, Lexington, head the company and will be in charge of the work.

The Globe Malleable Iron & Steel Co., 101 Greenway avenue, Syracuse, N. Y., manufacturer of malleable castings, forgings, etc., has completed plans for the erection of an addition to its plant for increased capacity. The new structure with equipment is estimated to cost about $120,000. It is proposed to rush construction work and have the building ready for occupancy at an early date.

The Chicago Steel Foundries, Inc., Thirty-seventh Place and Kedzie avenue, Chicago, Ill., has filed plans for the erection of an addition to its plant to cost about $50,000. The structure will be of brick and steel, and will be equipped as a foundry. H. B. Bernard, 140 South Dearborn street, has the building contract.

At the annual meeting of the shareholders of the Dominion Steel Corporation, held in Montreal, June 18, the directors who, the day before, tried to secure a legal injunction to postpone the meeting on the ground that they wanted more information about the proposed British Empire Steel Corporation, were not re-elected to the board. The directors who opposed the holding of the meeting were: J. H. Plummer and E. R. Wood, Toronto, Ont.; William McMaster, George Caverhill and John Raoul Dandurand of Montreal, Que. The new board elected consists of Viscount Furness, Sir Clifford Sifton, Sir Henry Pellatt, Sir William Mackenzie, Sir William D. Reid, Hon. Frederick Nicholls, Stanley Elkins, M. P., Hon. Charles Beaubien, H. B. Smith, Edmund Bristol, J. W. Norcross, Sir Newton Moore, Benjamin Talbot, J. F. Stewart and Roy M. Wolvin.

A special meeting of the stockholders of the Nova Scotia Steel & Coal Co., New Glasgow, N. S., will be held June 25, for the purpose of considering and approving an agreement entered into between the company and the British Empire Steel Corporation on May 26 last.

The American Iron & Steel Corporation, of Cleveland, announces that it has acquired a site near Michigan City, Indiana, with the frontage on Lake Michigan, and will shortly begin the erection of a steel plant to include a blast furnace, 6 open hearth furnaces and a 12 mill sheet plant. The company also announces that later it will install a tube mill and various other finishing mills. This company is a subsidiary of the Lake Superior Iron Ore Company, of Cleveland, and was organized about a year ago to develop ore properties in the Minnesota ranges and in Canada. It announces that it will build three 12,000 ton boats for carrying ore to its plant.

The Chambersburg Foundry Company has been organized by Frank A. Moorshead and his associates to manufacture iron and steel castings.

The trustees of the estate of W. J. Rainey announce that the business heretofore carried on under the name of W. J Rainey has been incorporated and hereafter will be conducted as W. J. Rainey, Inc. The officers of the new corporation are: Roy R. Rainey, chairman of the board; Scott Steward, president and treasurer; L. L. Williard, vice president in charge of operations; John McElwain, vice president in charge of sales and purchases of raw materials; H. R. Ahrens, secretary. The executive offices of the company will remain at 52 Vanderbilt avenue, New York.

Bancroft Jones Corporation, of Buffalo, manufacturers of fabricated steel for buildings, has completed plans for their new fabricating plant in Buffalo.

The American Manganese Steel Company, of Chicago, announces that Walter Brinton, of Wilmington, Del., was recently elected to the fourth vice-presidency, he having formerly held the office of eastern manager.

The Taylor-Worton Iron & Steel Co., of Philadelphia, have under construction a modern machine shop at their 25th street plant.

Steel is now being melted by the Black Steel & Wire Co., Kansas City, in a 10-ton open hearth furnace with a maximum output of 30,000 pounds, installed by the McLain-Carter Furnace Company, Goldsmith Building, Milwaukee. The steel is being poured in 4, 6 and 8-inch ingots for rolling into rods. It is expected that the 4-inch ingots, after being cast will be rolled into rods with only one heating. The Black Steel & Wire Co. specializes in the manufacture of wire, wire rods, etc.

The new plant of the Youngstown Car Company, at Niles, O., turned out its first steel car on June 15. The car was a 55-ton capacity and was built for the C. & O. Railroad.

The Bethlehem Foundry & Machine Co., was recently incorporated in New York with an active capacity of $5,000.00.

H. W. Johns-Manville Company have under construction a plant valued at $5,000,000 in the city of Milwaukee.

Stanley P. Rockwell has resigned his position as vice president of Weekes-Hoffman Company, Syracuse, N. Y., to become metallurgist at Whitney Manufacturing Company, Hartford, Conn., change to take place July, 1920.

Eugene Schoen, general manager of the International Oxygen Company of Newark, N. J., has sailed for Europe to make an inspection of the company's branches in London and Paris and to extend the business of the company in France, England, Belgium, Germany, Switzerland, Sweden and Denmark, where reconstruction following the war has stimulated the demand for oxygen and hydrogen generating apparatus.

Frank G. Bitzer, formerly foreman for the Millers Falls Company, Millers Falls, Mass., has been appointed superintendent of a branch plant for the same company at Brattleboro, Vermont.

Some Pointers on By-Product Coke Oven Operations

BY-PRODUCTS COAL HANDLING SYSTEMS.

The economical handling of the coal and coke received and shipped in a by-product coke plant determines to a large extent the layout of the plant.

The tonnage of coal received in a modern by-product coke plant varies from 500 to 14,000 tons per day, and the resulting tonnage of coke produced and shipped varies from 300 to 10,000 tons per day. This material must be received, unloaded, handled and loaded without interruption to the operation of the rest of the plant. It is very essential that the layout and type of machinery installed are such that the large tonnage of material is handled economically.

Coal Handling Equipment—Unloading.

The by-product coke plants in the United States are usually located at some point distant from the mines so that the coal is trans-shipped either by rail, by water or by both rail and water. When the coal is received at the plant in boats or barges, it is unloaded by some type of the modern unloading tower, operating a bucket, which discharges to a unit in the handling system. When a storage and rehandling bridge is installed, the storage pile can be arranged so that the bridge may be equipped with a cantilever span extending beyond the dock line, thus permitting use of the same unit for unloading, storing and rehandling.

When trans-shipped by rail, the coal is usually received in standard bottom dump cars from which it is dropped to track hoppers. Where standard gondola cars without bottom gates are received in sufficient numbers, a car dumper unit is provided which clamps and revolves the car, dumping the coal into hoppers. In either case it is fed from the hoppers by reciprocating feeders to the conveyors of the coal handling system.

Storage.

It is generally necessary that some coal storage capacity be provided against the contingencies resulting from strikes, accidents, freight congestion or closed navigation. It also is necessary in some plants, particularly those making domestic coke, to provide coke storage, as the shipping may be affected by any of these causes and because the demand for fuel is heavier during a limited season.

In small plants or plants not requiring a large storage, standard locomotive cranes equipped with clamshell buckets are sometimes used for this purpose. This is generally a temporary expedient as their capacity is relatively small and if several units are used the plant is so designed that more economical storage and reclaiming units may be installed later.

In some of the smaller plants, where the tonnage of coal and coke to be handled per day is not too large, a wide gauge, fixed radius, revolving crane operating a fair sized clamshell bucket is used with satisfactory results. With this type of equipment coal and coke are dumped into large digging pits from where they are handled by the crane to the storage pile and rehandled by the same units from the storage piles direct to cars.

In large plants or in the moderate size plants where the storage problem is of sufficient magnitude to warrant the expenditure, a storage and rehandling bridge is used. This gives large storage space, a greater hourly rehandling capacity, low handling costs and flexibility of storing and reclaiming. This latter point in the case of domestic coke storage is of very great importance. Coal is generally delivered to the bridge by means of a belt conveyor which parallels the storage pile, this conveyor being so tied into the coke handling system as to allow its use for delivering coke to the bridge. The bridge is usually equipped with an arrangement of conveyors for delivering the material to storage. The coal and coke is reclaimed and returned again to the conveying system by the bridge.

Coal Handling and Preparing.

The "run-of-mine" coal which is received from the unloading units is carried by belt conveyors to the preparing building, in which are located crushing, pulverizing and mixing units. Where but one kind of coal is charged into the ovens, the only preparation required is to reduce the size to about 1¼ inch cubes and to remove the refuse. If the coal is practically free from refuse, specially designed roll crushers are used. When too much refuse is found in the coal received at the plant to permit the use of roll crushers without injury to them, breaker units are installed for reducing the coal to the proper size and removing the refuse. The refuse, consisting of bone coal, rock or any stray iron, such as mine car wheels, coupling pins, etc., is discharged directly to cars or bins and the crushed coal is delivered to belt conveyors which carry it to the coal storage bins located at the coke ovens. From the bin it is transferred by charging larries to the ovens.

When high volatile and low volatile coals are mixed to produce the required quality of coke, the coals must be pulverized in order to insure an intimate mixture. In this type of plant it is necessary to install hammer crushers in addition to the breakers for pulverizing the coal.

The breakers commonly are located in the same building with and above the mixing bins, mixing conveyors and hammer crushers. The mixing conveyors, located beneath the mixing bins, have different relative speeds and the proportion of coal drawn from each bin is varied by adjustable measuring gates. These conveyors deliver at a common point to a proportioning hopper, which spits each stream of coal into several equal parts, depending on the number of hammer crushers installed. This coal, evenly proportioned and distributed, is delivered by gravity to the hammer crushers located below, from where it is transferred by belt conveyors to the coal storage bin at the ovens. In some plants the breakers or hammer crushers, or both, are located in a separate building, according to local conditions.

Coal Washing.

The coal industry of the United States has only recently reached a point where the washing of coal has become a matter of considerable importance. With enormous fields of very high grades of coal, it has been easier in the past to mine and use coals which required the least preparation, rather than to produce low grade coals which required a great deal of cleaning before they could be used

The development of the by-product coke industry has placed a greater demand on the coal fields, and as a result it is becoming more and more necessary to wash coal for by-product coking purposes.

THE KOPPERS CO.

Designers and Builders of

By-Product Coke Plants, Benzol Recovery Plants, Motor Fuel Recovery Plants, Ammonia Recovery Apparatus, Tar Distilling Plants, By-Product Gas Producers, Gasoline Absorption Plants.

CONSULTING ENGINEERS

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By-Product Coke and Gas Plant and their Auxiliaries

Properties Examined
Engineering Reports and Financial Statements Prepared
Coals Analyzed and Tested

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PITTSBURGH, PA.

Co-operate: Refer to The Blast Furnace and Steel Plant

ARE you taking advantage of our forty years of experience in applying our knowledge of Mill Bearings to working conditions? It is not our desire merely to offer our product for the purpose of securing orders. We want your business, it is true, but we want you to be satisfied with your purchases. Damascus Bearings are Better Bearings, scientifically and accurately made. But there may be one kind that is best for your requirements. We, therefore, invite your inquiries so that we may intelligently co-operate with you to bring about the highest degree of bearing service.

Write to us for any information you need along this line.

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PITTSBURGH

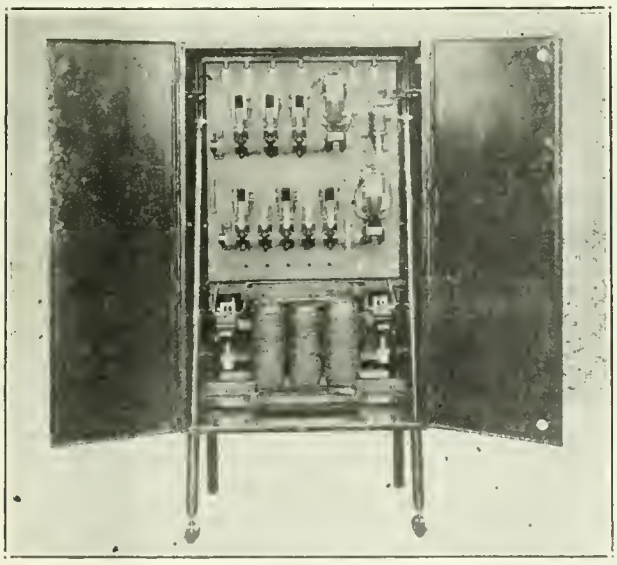
WITH THE EQUIPMENT MANUFACTURERS

AUTOMATIC STARTER FOR INDUCTION MOTOR.

The General Electric Company have developed an automatic starter suitable for use with squirrel cage induction motors when they are driving line shafts, pumps, compressors and similar devices.

These starters are designed for use for starting by push button, or by the operation of a float switch, pressure governor, or some similar automatic accessory.

A complete starter consists of one five contactor for starting, one three pole contactor for running, a current limit relay for controlling these contactors, two inverse time element overload relays and a set of compensator coils. All this apparatus is mounted on a panel, and enclosed in a case which is provided with facilities for locking it shut when desired. It must be constructed so that it can be mounted either on the wall or on a pipe framework. The compensator proper is designed to be hung from a conduit box, which is separable so as to facilitate wiring.



Automatic Starter Board.

The operation in starting is simply as follows. When the master switch, whatever form is used, is closed, the five pole starting contactor is closed, which connects the compensator coils to the line, and the motor primary leads to taps on the coils, thus reducing the starting voltage. The accelerating relay is also connected to the line circuit, and at a predetermined current value, for which it is set it operates, opening the circuit to the starting contactor coil, and closes the circuit of the three pole running contactor coil. This circuit is held closed by means of a small shunt coil.

An interlock on the starting contactor completes the circuit to the line contactor coil when the former opens, thus preventing the closing of the starting contactor before the running contactor has opened. The starting contactor is further provided with a normally open interlock which makes it unnecessary to hold the start button or other device in during the starting period.

The contactors used have solid copper contact tips that are easily renewable and are provided with magnetic blowouts and moisture proof coils. They are of a type that experience in steel mills and on cranes and other heavy duty apparatus that requires continual starting, stopping and reversing of heavily loaded motors proved will stand up well under the most exacting and severe service.

The compensator winding has two coils for two-phase motors and three for three-phase, which insures balanced starting currents, and maximum starting torque per ampere line current. The taps terminate in an accessible place in front of the compensator coils, so that the set most suitable for any particular application may be readily selected.

By means of this starter the automatic starting of the motor is properly accomplished independent of the operator's judgment. This is accomplished through the accelerating relays or current limit relays which operate the contactors so as to disconnect the auto-transformer and connect the motor on the line on proper acceleration.

Overload protection is furnished by two inverse time element relays which are operative during both starting and running. After an overload they may be reset, without removing the cover of the enclosing case, by means of handles which project through the panel behind.

LINK BELT CO. HOIST FOR FURNACE DOORS

Development of a foolproof hydraulic system for raising and lowering heavy doors on open hearth and heating furnace work is announced by the Link-Belt Company, of Chicago, after the first installation, at the plant of the Alan Wood Iron & Steel Company, Conshohocken, Pa., has been in continuous operation for 14 months.

Doors operated by this method, it has been demonstrated, always go up to the proper position, and always go down to the proper position, no matter what their weight may be.

Five hoists, with an automatic release, are used. On each hoist is mounted a pair of chain sheaves, attached to a worm wheel shaft between two flanges, which are pinned to the shaft and supplied with fiber friction surfaces on the sides toward the sheaves. The worm wheel is driven by a worm mounted on the shaft of a reversible motor, the worm and wheel being inclosed in suitable housing.

To raise the furnace door, the motor is started in the direction which will pull down on the left hand chain. As long as the counterweight continues its pull, the sheaves squeeze out against the flanges, and are thereby driven in the direction which will wind up the left hand chain, and thus lift the door.

The right hand sheave has a fixed stop on its periphery, so located that it will come in contact with a stop on the bottom casting when the furnace door has reached its proper height. With the motion of the right hand sheave arrested by this stop, the shaft cannot rotate the left hand sheave further because the squeeze between the sheaves and friction flanges are relieved. There is no opportunity, therefore, for overwinding, and if, through carelessness the current is not shut off promptly, the shaft with its flanges will simply continue to revolve in a sliding frictional contact with the sheaves, but without the power to grip and rotate them further.

TRADE PUBLICATIONS

The General Fireproofing Company, Youngstown, O., in the May issue of their magazine "General Fireproofing," give some very interesting articles on "Industrial Housing," one of the vital questions facing the large manufacturers of today.

Wellman - Seaver - Morgan Company have recently issued a booklet covering the operation and installation of a Hughes gas producer. It is most interesting to the trade.

Davis-Bournonville Company has issued a booklet describing antylene generators, welding and cutting torches and cutting outfits. Each operation is very vividly illustrated.

General Electric Company have recently published a most interesting article on "Arc Welding for Foundries."

"Coal Catalog and Coal Field Directory," 9x12 in., pp. 1136, price $10.00. E. N. Zern M. E. editor, Keystone Consolidated Publishing Company, 711 Penn avenue, Pittsburgh, Pa., publisher, is a technical and trade publication and a most complete directory. The directory gives the names and addresses of all coal producing companies, location of mines, railroad facilities, seam of coal operated, names and addresses of mine officials and purchasing agents.

The technical department contains discussions by the most representative specialists in each field. It contains such articles as: "Coal vs. Fuel Oil," "Purchasing Coal on a Btu. Basis," "Coal Storage," "Coal Preparation," "Fusibility of Coal Ash," "Qualification of Coal for Fifteen Different Uses," and many additional articles of interest to mine officials and purchasers of coal. It contains tables, giving analyses of all coal seams mined in the United States and foreign countries, according to specific gravities, fusion points, adaptability for various commercial usages and physical structure, and a list of beehive and by-product coke ovens arranged by states.

A part of the volume includes advertisements of the foremost coal producers, coke manufacturers, coal sales agencies and analysts. Many of the advertisements contain descriptions and illustrations of operations and properties. The 1920 edition contains vastly more information than former editions and is possibly the most authentic and recent publication, covering the different phases of the mining industry.

"The Relation Between the Elastic Strengths of Steel in Tension, Compression, and Shear," by F. B. Seely, Associate Professor of Theoretical and Applied Mechanics, and W. J. Putnam, Associate of Theoretical and Applied Mechanics, has been issued as Bulletin No. 115 of the Engineering Experiment Station of the University of Illinois. The severe uses to which carbon and alloy steels are put in some places of engineering, as for example, in automobile and in aeroplane construction, have developed a need for more detailed knowledge of the action of steel, under various types of stress, as well as of the factors which affect the physical properties of the material. This bulletin presents the results of experiments with six grades of steel, three carbon steels and three alloy steels; namely, soft, mild, and medium carbon steel and vanadium, nickel, and chrome-nickel alloy steel. The elastic strength in tension, in compression, and in shear is given for each of the six grades of steel. Copies of Bulletin No. 115 may be obtained without charge by addressing C. R. Richards, Director, Engineering Experiment Station, University of Illinois, Urbana.

TRADE NOTES

The American Manganese Steel Company announces that Walter Brinton, who was manager at their New Castle, Del., plant for several years, has been elected vice president of this company.

The Penn Seaboard Steel Corporation's new blooming mill at New Castle, Del., is now in operation. This mill is a two high, 36 inch reversing mill, directly connected to 6,000 hp Westinghouse motor, and equipped with motor driven screwdown and manipulator. Three additional gas producers and two new soaking pits have also been installed. Shears are of the guilletine type, motor driven, capable of shearing 8x8 inch. This mill has a capacity of 20,000 tons of billets, blooms and slabs per month.

Alois Hauser has been appointed assistant to the works manager in charge of engineering, of the Timken Roller Bearing Company, Canton, O. For the past several years Mr. Hauser has been efficiency engineer at the Saucon plant of the Bethlehem Steel Company.

Recent advertisements of the Westinghouse Union Battery Company, Swissvale, Pa., have, unfortunately, led many to assume that the Westinghouse Electric & Manufacturing Company was entering the storage battery field. In order to clear away any misunderstanding, the Westinghouse Electric & Manufacturing Co. authorizes the statement that the Westinghouse Union Battery Company is owned and controlled by the Westinghouse Air Brake Company, Wilmerding, Pa., and the Westinghouse Electric & Manufacturing Co. is not in any way connected with the manufacture, sale, distribution or service of its product.

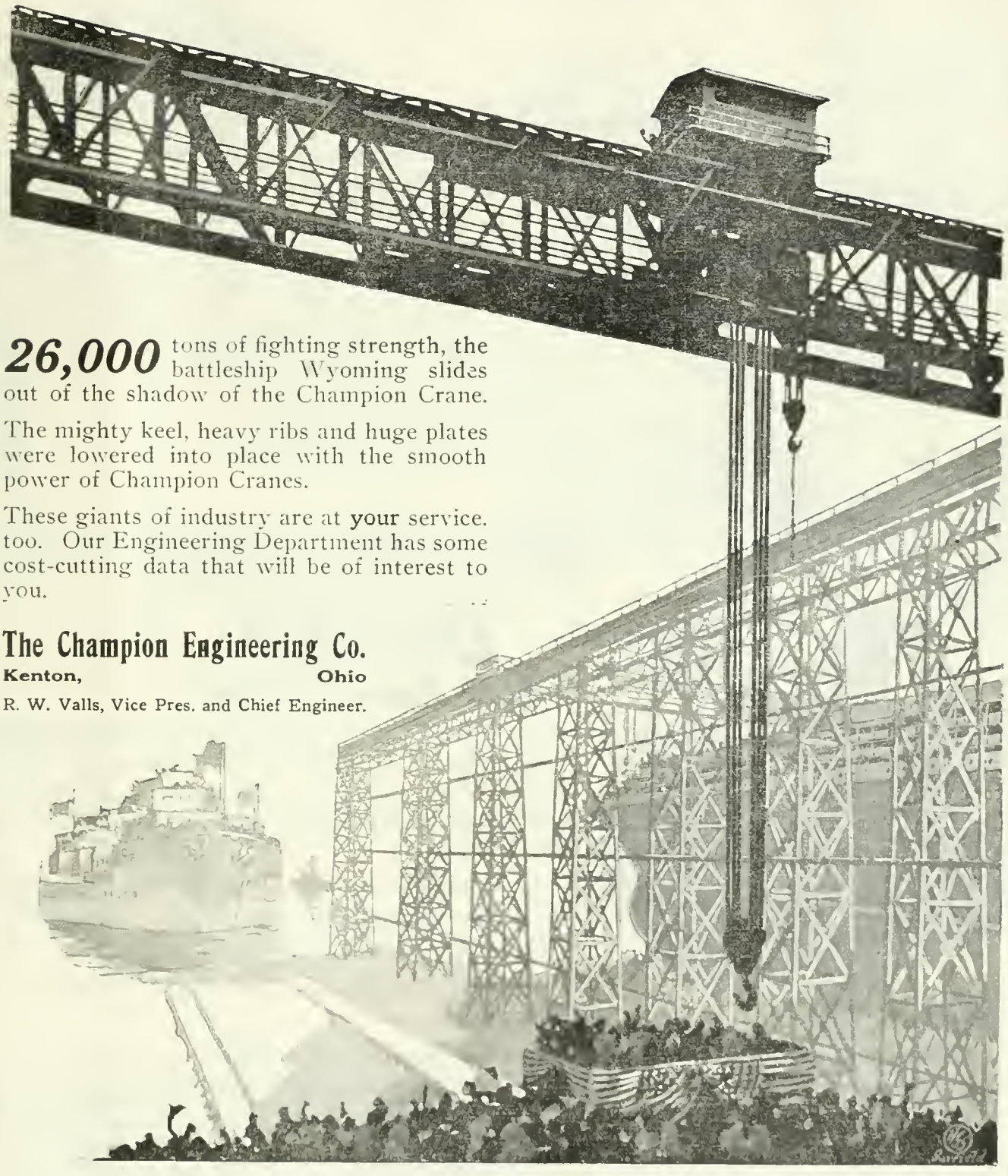
George P. Mills, formerly Electrical sales engineer of the General Electric Company, Philadelphia, has joined the staff of the Electric Furnace Construction Company, Philadelphia, to take charge of and specially develop electrical industrial heating furnaces.

At the annual meeting of the stockholders of the Westinghouse Electric & Manufacturing Company, which was held at East Pittsburgh, Pa., June 9, the following directors were unanimously re-elected for three years: Guy E. Tripp, chairman of the board of directors of the Westinghouse Electric & Manufacturing Co., New York City, Joseph Marsh, president of the Standard Underground Cable Company, Pittsburgh, Pa., H. H. Westinghouse, chairman of the board, Westinghouse Air Brake Company, New York City; Albert H. Wiggin, chairman of the board of the Chase National Bank, of New York; George W. Davison, president of the Central Union Trust Company, of New York City, who was selected by the board of directors to succeed James N. Wallace, deceased, was elected by the stockholders for the term expiring June, 1921.

At a recent meeting of the board of directors of the Hays School of Combustion Engineering, of Chicago, the following personnel of the educational staff was announced: Joseph W. Hays, educational director; W. L. Abbott, chief operating engineer, Commonwealth Edison Company; Joseph Harrington, formerly administrative engineer, U. S. Fuel Administration; Fred R. Low, editor of "Power"; L. E. Moultrop, construction bureau, Edison Electric Illuminating Company; David Moffat Myers, formerly advisory engineer, National Fuel Administration; S. W. Parr, department of chemistry, University of Illinois; Arthur L. Rice, editor of "Power Plant Engineering." The officers elected to conduct the business affairs of the school are: R. C. Acers, president; L. C. Pettitt, vice president and treasurer; R. G. Johansen, secretary and general manager.

The conference of delegates representing the national, local, state and regional engineering organizations of this country, which convenes in Washington, D. C., on June 3, 4, 1920, is the first meeting of the kind, and one of the most important that has been held in the history of the engineering profession in this country. It is the first attempt to bring about a solidarity in the profession through a federation of the engineering organizations in this country in a comprehensive organization dedicated to the city, state and nation.

The American Society of Civil Engineers was founded in 1852 by a small group of engineers for the purpose of promoting sociability of engineering knowledge and practice and the maintenance of a high professional standard among its members. Subsequently the American Institute of Mining and Metallurgical Engineers (1871), the American Society of Mechanical Engineers (1880) and the American Institute of Electrical Engineers (1884), and still later the American Society for Testing Materials (1898), the American Railway Engineering Association (1899), and other national engineering societies were formed. These are primarily technical societies and have practically no non-technical activities.



26,000 tons of fighting strength, the battleship Wyoming slides out of the shadow of the Champion Crane.

The mighty keel, heavy ribs and huge plates were lowered into place with the smooth power of Champion Cranes.

These giants of industry are at **your** service. too. Our Engineering Department has some cost-cutting data that will be of interest to you.

The Champion Engineering Co.
Kenton, Ohio
R. W. Valls, Vice Pres. and Chief Engineer.

CHAMPION CRANES

NEW YORK
J. W. Spensley,
149 Broadway.

PITTSBURGH
Laughlin-Barney
Machinery Co.

PHILADELPHIA
Williams & Thomas
Machinery Co.
820 Com. Trust Bldg.

PORTLAND, ORE.,
Portland Machy. Co.

SEATTLE
Hallide Machy. Co.

SAN FRANCISCO
Louis G. Henes
76 Freemont St.

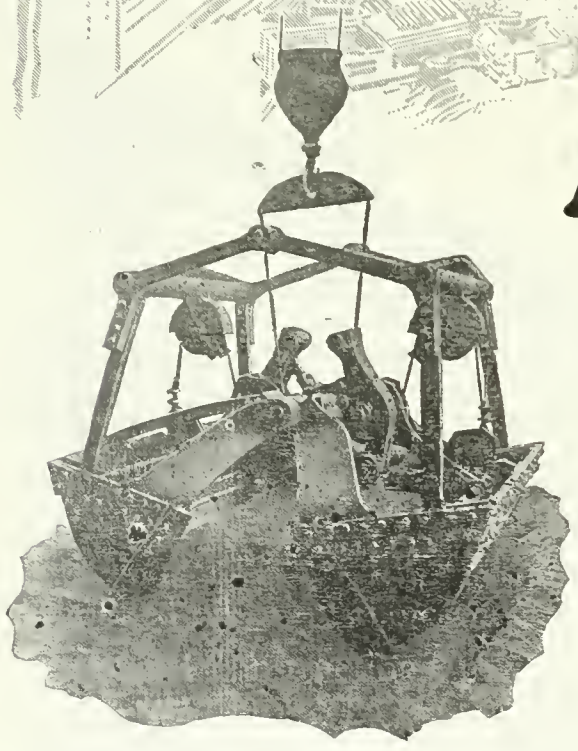
PARIS, FRANCE
L. & E. Frenkle, Inc.
20 Rue des Capucines

TOLEDO
W. C. Lloyd & Co.
1113 Second Nat.
Bank Bldg.

LOS ANGELES
Louis G. Henes
Title Insurance
Building

Co-operate:—Refer to The Blast Furnace and Steel Plant

BLAW-KNOX



Blaw Foundry Buckets

Low Head Room

An automatic grab bucket operating completely from the hook of any crane or hoist—requiring no changes in the lines nor hoisting machinery.

Unusually low head room—admirably adapted to the mixing and cutting of molders sand and to the rehandling of coal, sand and coke.

Can be operated by a single hoisting drum—hooked on or off the crane as its services are required.

Sturdy construction—it is so built that all shocks are absorbed by the working mechanism of the bucket. Its working parts are few—and amply protected against wearing and abrasive action.

We are prepared to serve you by furnishing a Blaw Foundry Bucket ***which is adapted to your crane***—write us.

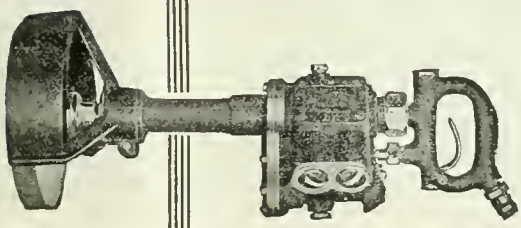
Note—The following products are built and trade-marked by Blaw-Knox Co.: Steel Forms for Concrete Construction—Clamshell Buckets—Fabricated Steel Specialties—Water Cooled Appliances for High-Temperature Furnaces—Pressed Riveted and Welded Plate Work—Standardized Sectional Steel Buildings.

BLAW-KNOX COMPANY

PITTSBURGH, PA.
615 Farmers Bank Bldg.

NEW YORK - BOSTON - CHICAGO
DETROIT - SAN FRANCISCO

Co-operate:—Refer to The Blast Furnace and Steel Plant



Thor

RUGGED STRENGTH

is what you get when you buy a THOR Portable Pneumatic Tool. All parts are heat treated, hardened, ground and lapped, making

A complete assembly that cannot be surpassed for speed, power and endurance.

Independent Pneumatic Tool Co.

Chicago, Illinois

Pittsburgh	Detroit
Cleveland	Montreal
New York	Birmingham
San Francisco	Boston
Philadelphia	St. Louis

"Specify Porter's Next Time"

You will notice that the largest industrial plants in many cases use PORTER'S exclusively.

Frequent breakdowns and delays are expensive these days and needless, too, if you select the right locomotive for the work.

H. K. Porter Company

Pittsburgh, Pa.

Co-operate —Refer to The Blast Furnace and Steel Plant

HELP WANTED

MILL LAYOUT DRAFTSMAN — by large New York firm of consulting engineers. Must have wide mill experience, designing and operating, and must be able to plan mills to produce different products from a given ingot tonnage. No others need apply. State fully education, salary and experience in detail, by whom employed and how long in each case. Applications treated strictly confidential.

ADDRESS C. P. P.

Care The Blast Furnace and Steel Plant
108 Smithfield Street, PITTSBURGH, PA.
f

FOR SALE

1—Bates Machine Co.
1800 HP single left hand non-condeusing Bates Corliss steam engine—34″x60″ extra heavy rolling mill type—outboard bearing—with 21′0″ dia. flywheel—two 10′0″ dia. rope sheaves—2 with 17-2″ grooves each—12″ steam feed 14″ exhaust—fly ball governor, with auto stop—gravity oiling system including contact oilers and pipe and fitting connections.

1 Mesta Machine Co.
24′0″ dia. cast iron rope wheel in 4 sections bolted and grooved for 34-2″ ropes—shaft 27″x18′0″ long.
2—24″x42″ adj. pillow blocks
2 cast iron flanged couplings,
31 lengths of 2″ rope 160 feet long 70 per cent good.
Delivery approximately six months.

THE CANTON SHEET STEEL COMPANY
of The Hydraulic Steel Co., Canton, O.
64

WANTED

Superintendent of steel mill desires position. Several years experience in strip and billet mills, also open hearth furnaces. References given.

BOX NO. N. F.,

Care The Blast Furnace and Steel Plant
108 Smithfield Street PITTSBURGH, PA.
71

ENGINES

The two following engines must be moved immediately, and we are offering them at sacrifice prices:

1—200 to 400 H. P. Heavy Duty 3-Bearing, Simple Engine, extra heavy.

1—400 to 700 H. P. Heavy Duty Corliss Engine, was used for rolling mill work and is arranged for belt drive and crab connection.

Unusually heavy with 16 inch main shaft and large bearings.

Both engines are in first-class condition and guaranteed.

Wire or Write

Power Equipment Co., Engrs.,
1809 Buttonwood St.,
PHILADELPHIA, PA.
tf

BLOWING ENGINES
FOR BLAST FURNACES

4 Wetherill Blowing Engines, steam cylinders 36″, air cylinders 84″ x 60″ stroke, will maintain air pressure of 15 pounds, all complete and first class condition. Immediate delivery.

J. F. DONAHOO COMPANY,
BIRMINGHAM, ALA.
tf

B. & W. BOILERS

Four (4) 524 hp. each, Babcock and Wilcox water tube boilers—steel headers, butt-strapped drums, single settings—180 pounds insurance based on factor of safety of 5.5—condition like new—Prompt delivery.

H. P. BREARLEY

Phone, Rector 9118 90 WEST ST., N. Y.
64

By-product coke and gas plant operating engineer available for position. M. E. graduate. Can qualify for assistant superintendent or efficiency engineer.

ADDRESS B. P. C.,

Care The Blast Furnace and Steel Plant,
108 Smithfield Street PITTSBURGH, PA.
f

POSITION WANTED

Designer, mechanical engineer, 18 years experience in designing apparatus for oil refinery, chemical, by-product coke oven and gas plants. Expert in steel plate constructions. Permanent position considered only.

ADDRESS BOX L. I.,

Care The Blast Furnace and Steel Plant
108 Smithfield Street, PITTSBURGH, PA.
62

POSITION WANTED

by Englishman at present in Pittsburgh as coke-oven superintendent or similar position. Knowledge of benzol, solvent, toluol, sulphite of ammonia, tar, pitch, creosite, anthracene, etc. Can furnish excellent references. Several years experience in both England and Wales.

Write M. CONWAY,
209 N. Highland Ave., Pittsburgh, Pa.
64

Electric Steel Rolling Mill Plant For Sale

In Pittsburgh District, close to and already connected with large central power station, affording good supply of electric power at reasonable rates. Railroad siding now in plant with track extended through building. River water supply available. Ten acres of ground, steel frame building 90x400 feet. Laboratory and office building on site.

Twenty-ton, three-motor traveling crane; two bottom tap core ladles; ingot moulds; 10-ton basic electric furnace; air compressor; hot top oven; hand tools of all character; locomotive crane; two 1,200 horsepower electric motors in plant but not erected. All other equipment has been operated for short period of time and is in condition for immediate use.

Arrangement of building makes is suitable for building sheet, bar or strip steel mill.

f

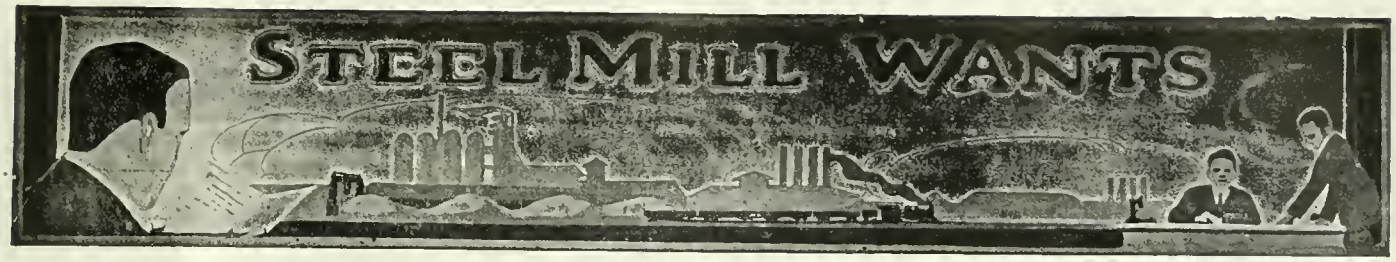
ADDRESS C. E. S.,

108 Smithfield Street, Care The Blast Furnace and Steel Plant. PITTSBURGH, PA.

RICHARDSON *for* RAILS

Constant stocks of New and Relaying Rails, Spikes and Bolts. Frogs and Switches. Tell us your requirements.

Richardson & Co., Inc.
2101 Oliver Building
PITTSBURGH, PA.



WANTED

Advertising Manager.

Must have successful record as such. Preference will be given to one with technical education or mechanical aptitude. Must have initiative and capable of taking over entire burden of the department and carry it well. Unusual opportunity to become an integral part of a well established and splendidly backed institution. When replying give full details and last three positions held and salary expected.

ADDRESS BOX 851,
Detroit, Mich.

f

STEEL PLANT DRAFTSMEN

Wanted for large rolling mill development and general work appertaining to Coke Ovens, Blast Furnace, Open Hearth and Rolling Mill Departments. Give record of former engagements, age, salary and date can report. Address

CHIEF ENGINEER,
Algoma Steel Corporation, Ltd.,
Sault Ste. Marie, Ont., Canada.

f

CHEMIST AND METALLURGIST,

university training, several years experience in analysis of ores, metals, ferro-alloys and alloy steels. Also experienced in plant research work. Will consider proposition to take charge of laboratory. Will be especially interested in position as assistant to metallurgist or melter.

BOX CHC
Care The Blast Furnace and Steel Plant,
108 Smithfield Street, PITTSBURGH, PA.
64

SALESMEN WANTED

If you call on superintendents, managers, engineers or purchasing agents of steel plants regular, and are in a position to entertain an exclusive commission sales agency proposition to be handled as a side-line, it may pay you to get details. One party has been making from $4,000.00 to $6,000.00 per year out of the proposition and only operating in two states. No samples to carry. References exchanged.

1161 ARCADE BLDG., ST. LOUIS, MO.

f

FOR SALE

Two Laidlaw-Dunn-Gordon Company 11″x18″ and 11″x18″ Cross Compound Rolling Mill Frame, Meyer Valve Gear Flywheel Pumping Engines.

In Excellent Condition

Capacity each unit 1,500 gallons per minute against 44 pounds pressure.

At 52 R.P.M. steam pressure 135 pounds.

Maximum capacity 2,000 gallons at 70 R.P.M.

Floor space each unit 11′ 0″x23′ 0″.

For inspection and price apply to
Engineering Department,

Whitaker-Glessner Company,
Portsmouth, Ohio.

72

Do you want men, equipment or a position? Try The Blast Furnace and Steel Plant Classified Section. It gets results.

Electric Truck For Sale

One Type "G" Automatic Transportation Company electric truck, serial No. 343. Platform 36″ wide by 66″ long. Equipped with 36 Edison "A-4" cells. Cells and truck in good condition.

The Eastern Malleable Iron Company,
Naugatuck, Conn.

74

WANTED

Young man 25 to 30 years of ag to take charge of Metallurgical Department in an Iron & Steel Industry in Eastern Pennsylvani. College graduate preferred and one who is familiar with electric steel. Good opportunity for advancement to the right party.

BOX T. E. C.
Care The Blast Furnace and Steel Plant
108 Smithfield St., PITTSBURGH, PA.
f

POSITION WANTED

as **Chief Engineer** of small plant or as **associate with Consulting Mechanical Engineer**, by Mechanical Engineer with 17 years experience on steam, gas and electric power plants and the mechanical engineering for steel mills. Now holding responsible position in Pittsburgh. Character of the connection is more important than salary. Address

ADDRESS BOX F. C. A.
Care The Blast Furnace and Steel Plant
108 Smithfield Street, PITTSBURGH, PA.
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When In Need

of new or second hand equipment —
of a good man for that job—
of a good position —
of disposing of second hand equipment

Use the Classified Section of
The Blast Furnace and Steel Plant

Co-operate:—Refer to The Blast Furnace and Steel Plant

ECONOMY renewable FUSES

were the first line using an inexpensive bare link for restoring a blown fuse to its original efficiency to be approved ***In All Capacities*** by the Underwriters' Laboratories. This honor was not won on laboratory tests alone, but largely because for many years millions of Economy Fuses have been giving dependable protection, high efficiency and working marked economies. When you order fuses insist on ECONOMY.

For sale by all leading electrical jobbers and dealers.

ECONOMY FUSE & MFG. CO.

CHICAGO, U. S. A.

Economy Fuses also are made in Canada at Montreal.

SPRACO
THE ONLY CENTER JET NOZZLE
SOME OF THE ADVANTAGES OF
SPRACO COOLING PONDS
Low installation cost. Require 50% less power to operate than a cooling tower of the same capacity in water handled. Maintenance cost a negligible item. A continuous supply of cooled water with an average vacuum of 28" the year round.
SPRACO COOLING PONDS
With the exclusive Spraco Center-Jet Nozzle have proved their efficiency and economy under the most severe conditions in practically every industry.
You'll be interested in Bulletin C-8—write.
Spray Engineering Co.
Also manufacturers of Spraco Air Washers, Spraco Pneumatic Painting Equipment and Vaughan Flow Meters.
BOSTON, MASS.

GET YOUR O. H. BACK INTO OPERATION IN RECORD TIME.

Eliminate the costly sledge hammer method of removing slag and save time, money and labor.

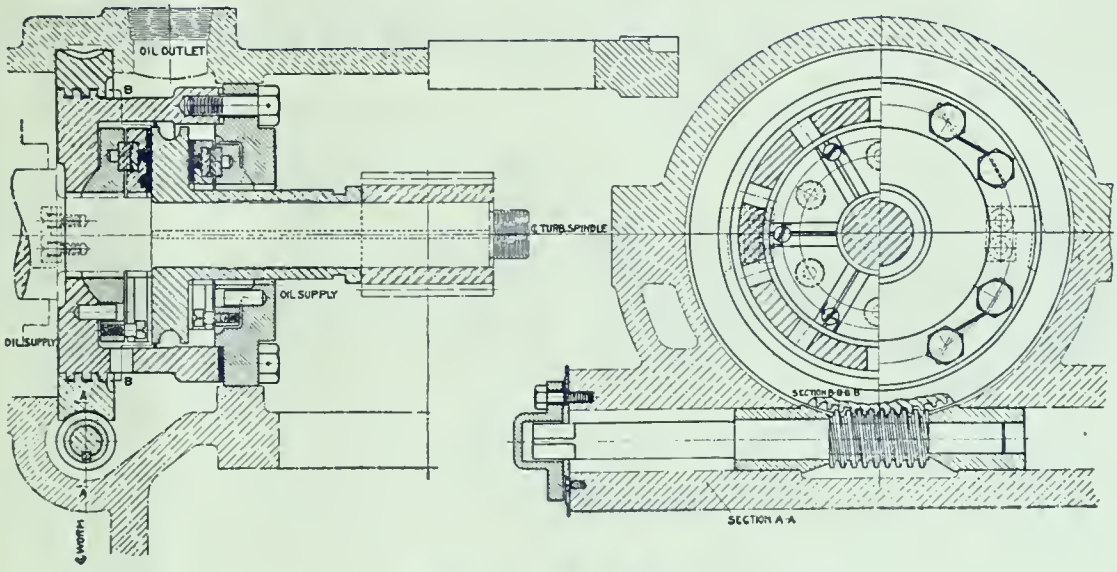
FLEXIBLE SLAG GUN

for removing slag from open hearth pockets. The use of this slag gun means time saved in getting the O. H. back into operation. Operates on air pressure of 75 pounds and up. Strikes a blow far more powerful than sledge. No complicated parts. Easy control. No kick. Write for details today. It will pay for itself in time saved.

Rivet Cutting Gun Co.

CINCINNATI, OHIO

Reliable, and Why—



The Kingsbury thrust bearing carries enormous loads per sqnare inch of area because of the self-adjusting segments which set themselves at an angle with the plant of the thrust disc, corresponding to the thinning of the oil film as it is squeezed between the surfaces.

End Thrust—
and the Kingsbury Thrust Bearing

The strictly double-flow turbine, in which the steam divides equally and flows in both directions from the center has no end thrust.

Other designs have end thrust, and means must be provided to counter-act the thrust so that the rotor will remain in its correct axial position.

The Kingsbury Thrust Bearing, used on all Westinghouse turbines in which there is end thrust, possesses a degree of dependability exceeding any construction ever employed in this country.

500 lbs. per sq. inch may be carried indefinitely.

5,000 lbs. per sq. inch have been carried experimentally.

Installed on the Westinghouse Steam Turbine, the pressure commonly carried is about 300 lbs. per sq. inch.

The illustration shows the construction of this bearing.

The extraordinary ruggedness and reliability of the Westinghouse Steam Turbine, are due to the thoroughness with which every detail has been carried out, and the large factor of safety employed in its design.

WESTINGHOUSE ELECTRIC & MFG. CO.
East Pittsburgh, Pa.

1129

Westinghouse

Republic

Flow Meters are not just flow meters, but

Flow Meters +

Plus What?

Plus Service

Republic Flow Meter Co.

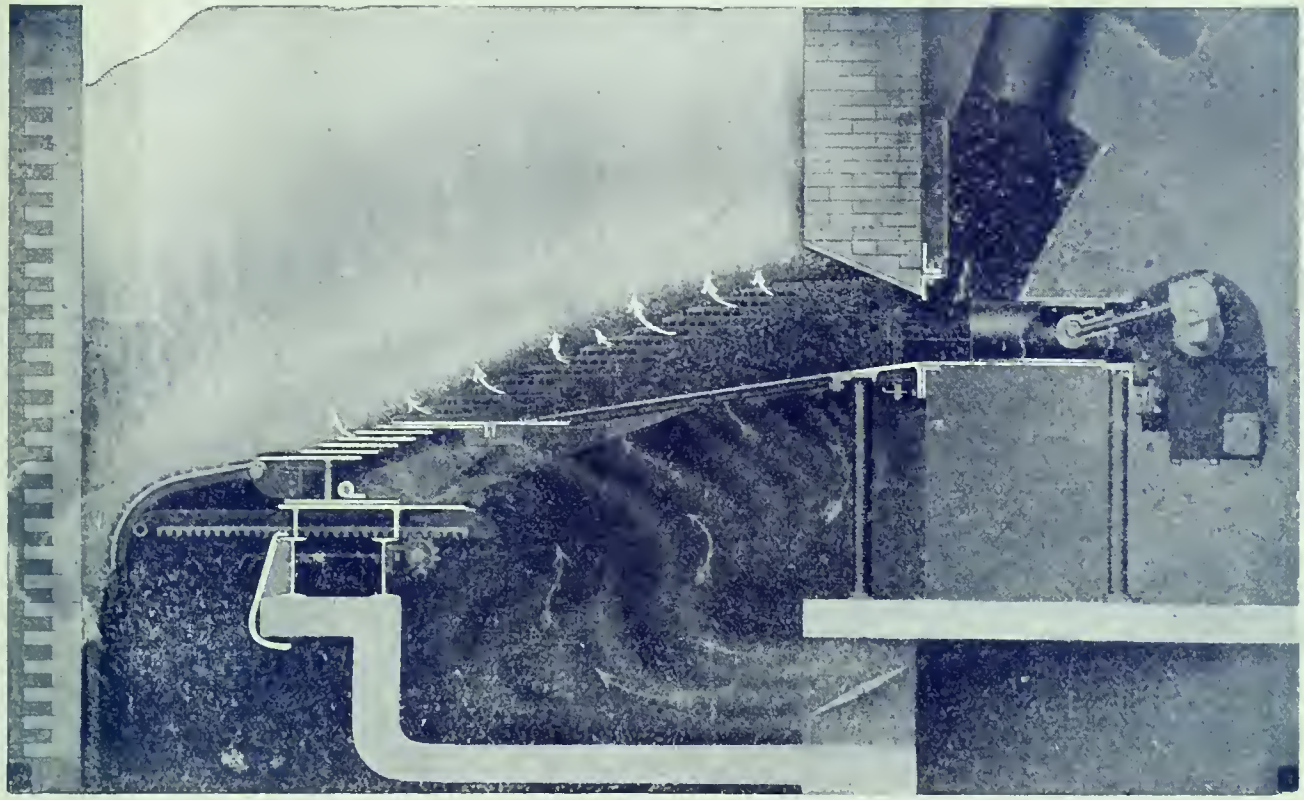
565 Washington Blvd. Chicago, Illinois

BRANCH OFFICES

New York Philadelphia Boston Pittsburgh Atlanta Detroit
Toronto, Canada

Republic Flow Meters

Co-operate:—Refer to The Blast Furnace and Steel Plant



Let Riley Stokers Reduce Your Costs

Riley Stokers are always on the job—you can rely on them to be at work every day. They are tireless--working all hours of the day and night—without complaint.

Industrial plants can cut their operating costs to a minimum by using Riley Underfeed Stokers. Consider the following facts:

EFFICIENCY—Boiler tests on Riley Stokers have shown over-all efficiencies of 80% and higher.

LABOR SAVING—One or two men can replace ten or twelve required for hand firing. Continuous, automatic discharge of ashes means elimination of drudgery in fire cleaning. Labor for ash handling in a well laid out plant is negligible.

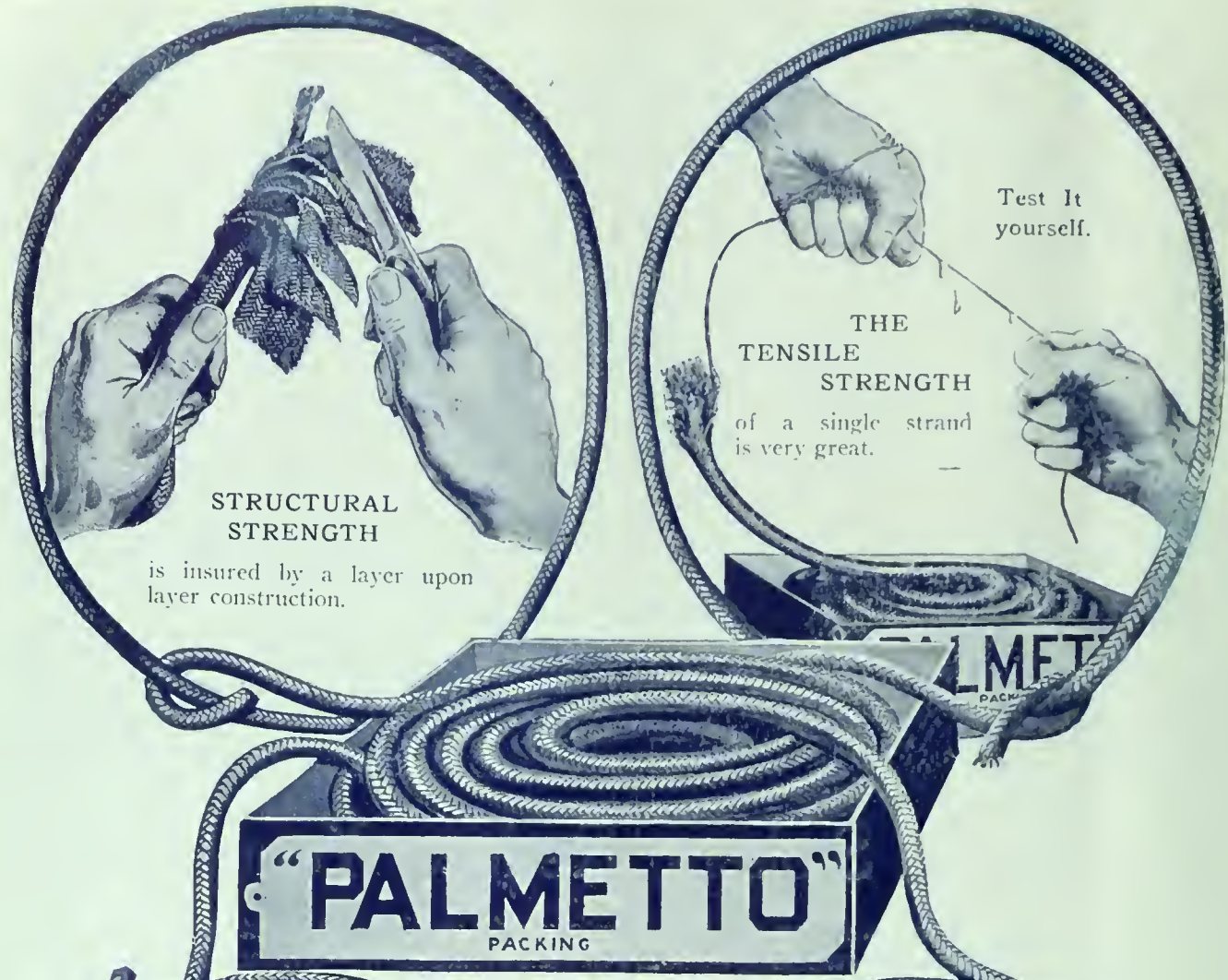
CAPACITY—Capacities of 300% and more can be obtained over long periods which means few boilers with corresponding decrease in investment and maintenance.

COMPLETE COMBUSTION—The underfeed method and moving grates intimately mix the proper amount of air and coal, giving perfect combustion.

For further details on the savings possible, send for Catalog B-7.

SANFORD RILEY STOKER COMPANY WORCESTER, MASS.

RILEY UNDERFEED STOKERS



THREE REASONS
Why
"PALMETTO"

packing is superior for high pressure, superheated steam and compressed air.

It gives longer service than other packings and is therefore more economical.

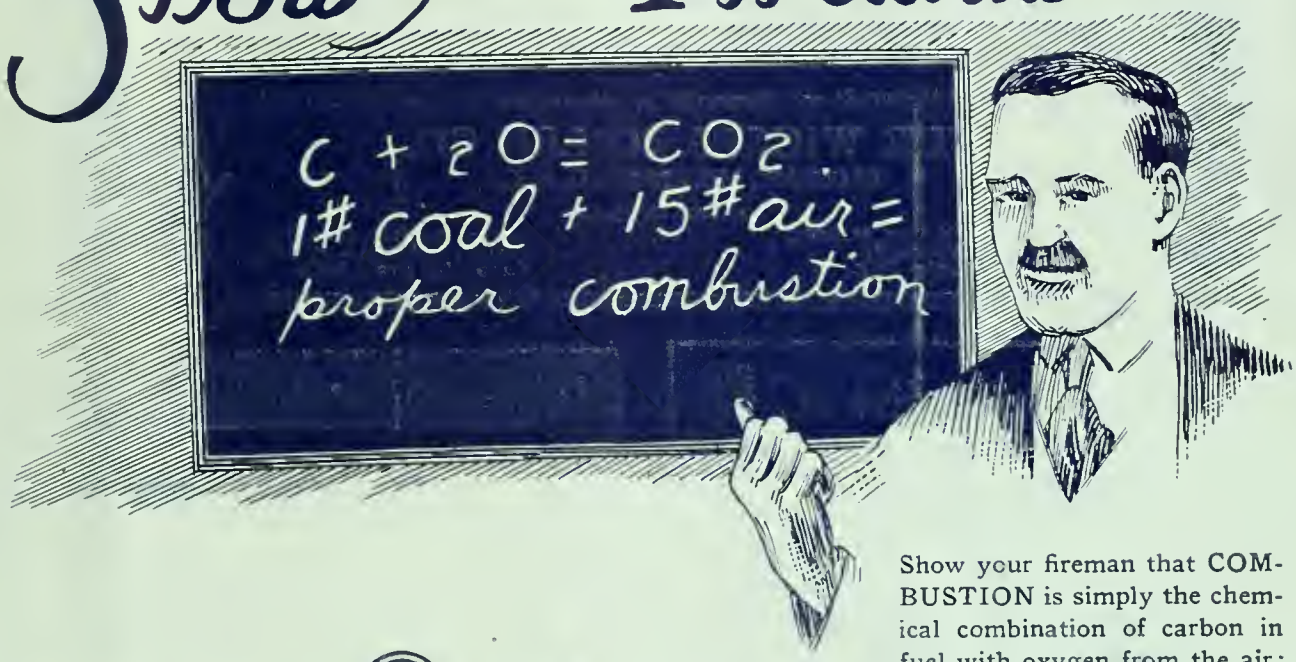
Let us send you a working sample to test under your own conditions —no charge.

GREENE, TWEED & CO.
Sole Manufacturers
109 Duane St. New York

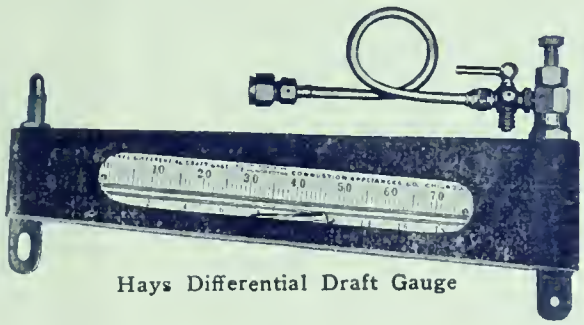
Its graphte grease lubricant prevents friction.

Lubricant is forced into each single strand before braiding.

Show your Fireman



Show your fireman that COMBUSTION is simply the chemical combination of carbon in fuel with oxygen from the air; that perfect combustion consists in bringing together the proper proportion of each, and that too much draft means a lot of extra air to be heated up to 500° or more with heat that might just as well produce steam.



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Then equip each boiler with

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and both you and your fireman will know what is happening in the boiler room. Your fireman will be able to make the proper adjustments to better his efficiency. He will not have to guess. He will know when, how and why to act. Naturally he will take a new interest in his work—if you will but do your part.

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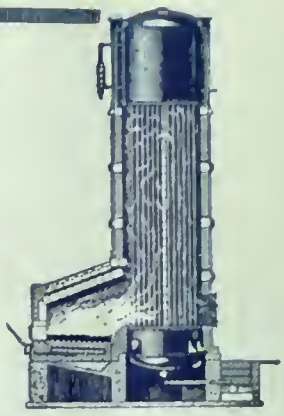

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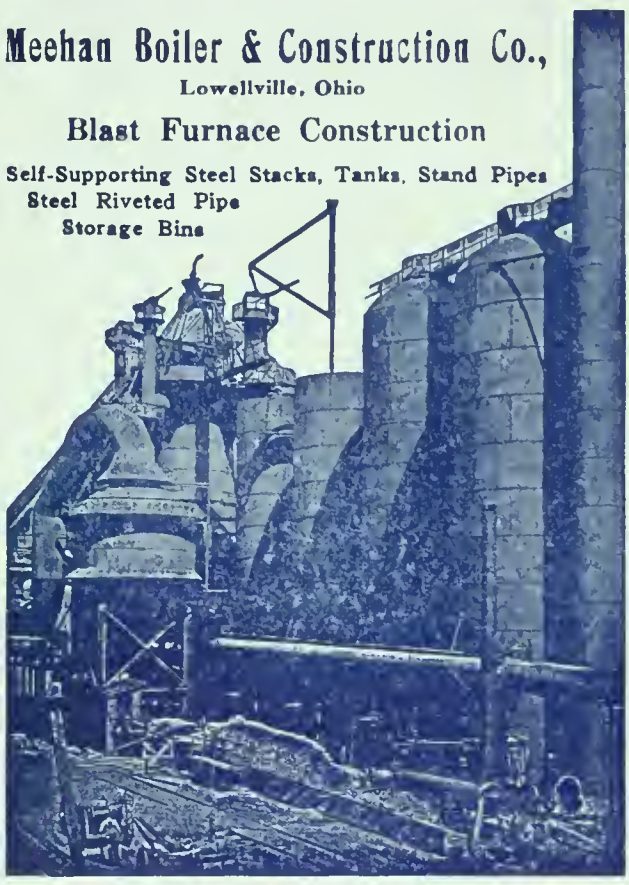

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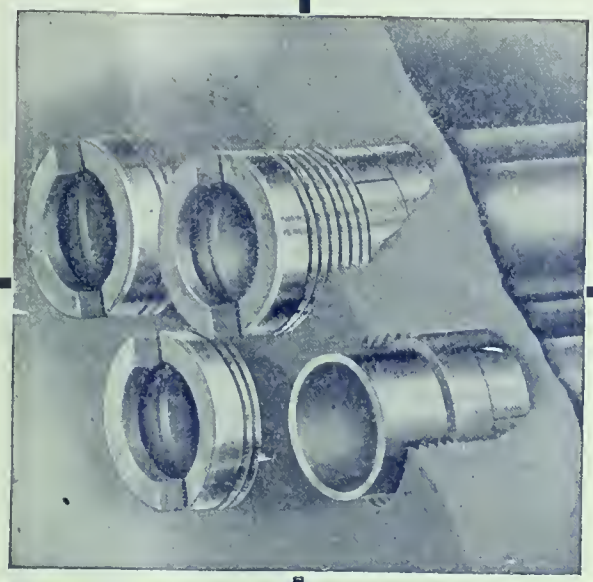

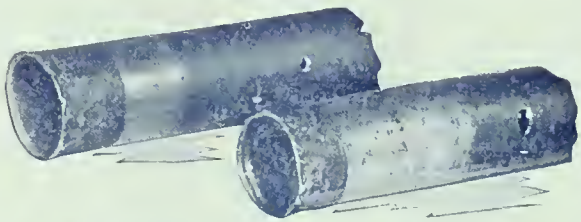

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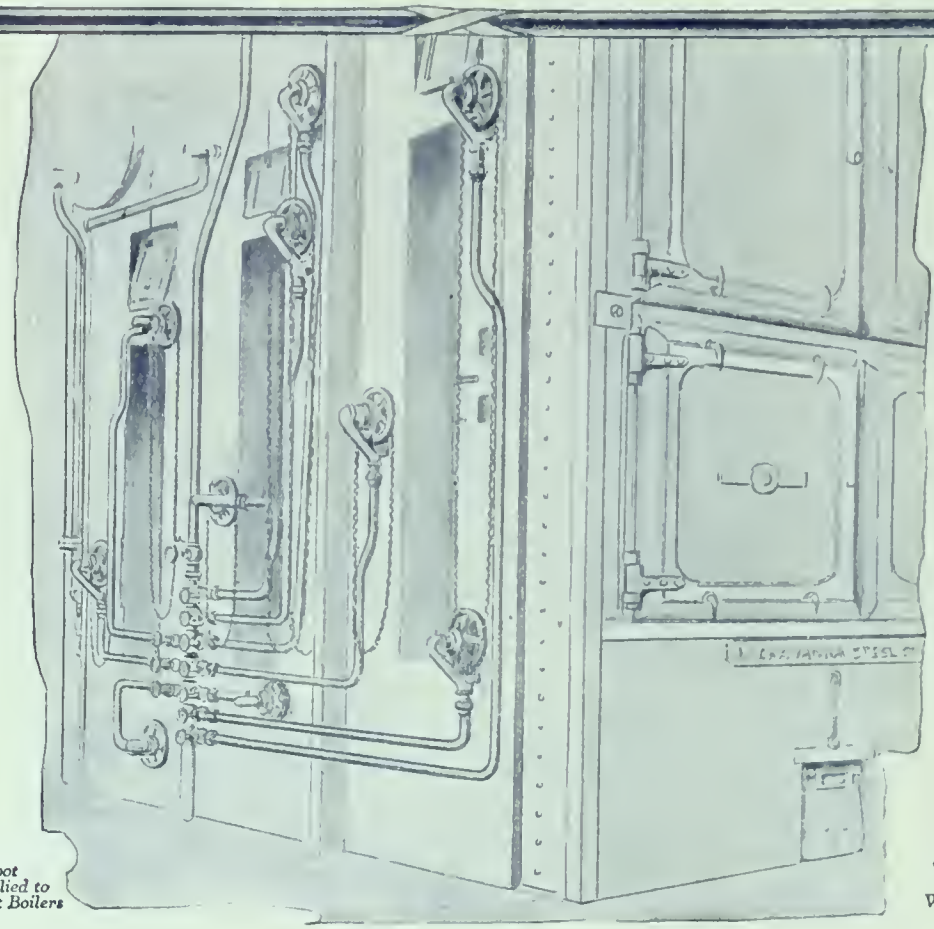

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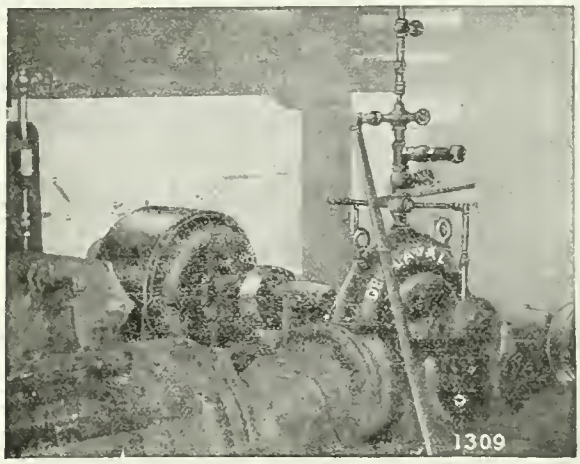

De Laval Motor-driven Pump handling 1,600 gals. per minute against 180-ft. head.

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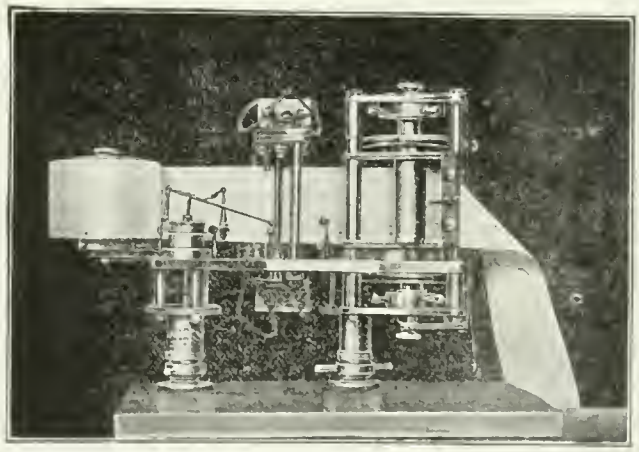

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(Caskey Patents)

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It is pressure packed, which means that the higher the pressure the tighter the valve holds.

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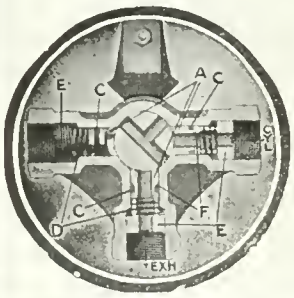

Description

A—Extra long special soft bronze sealing bushings.

D—held tight against plug by this spring.

E—retaining nut holding spring in place.

C—extra filled hydraulic leather washers.

F—vents for admitting pressure behind C.

Rotary part of valve self-grinding on A.

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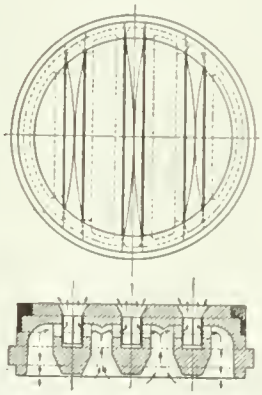

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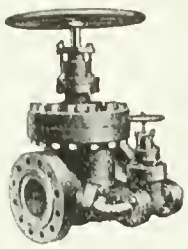

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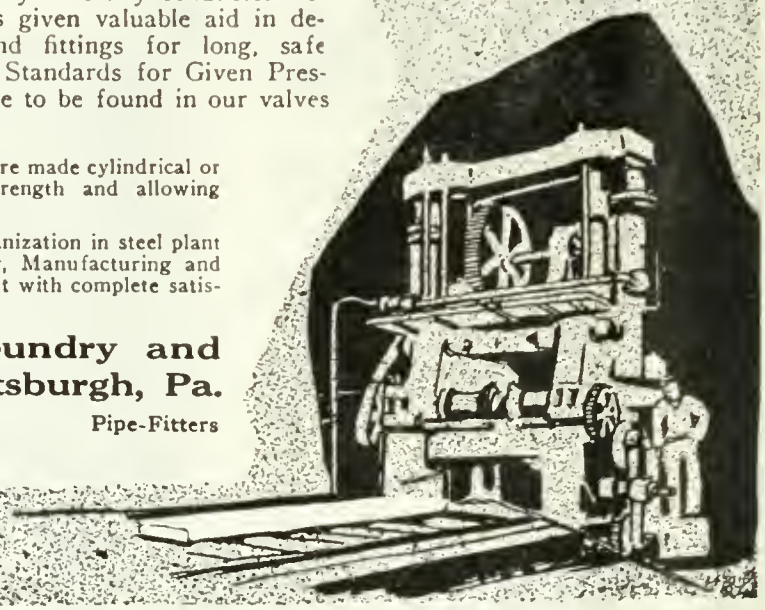

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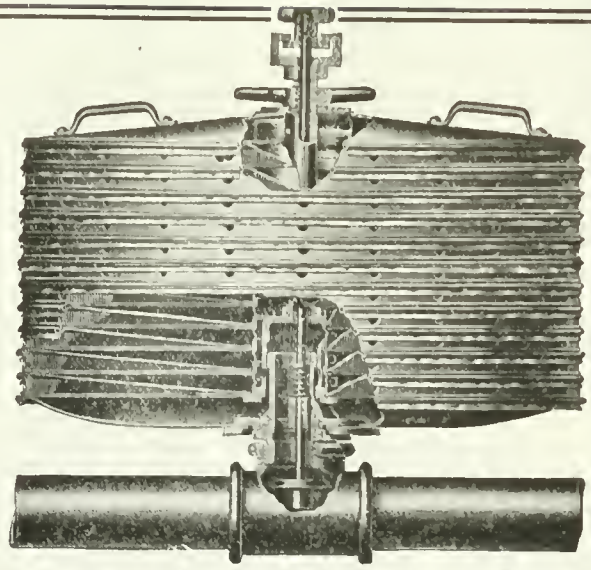
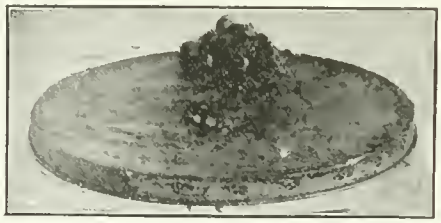


No. 1—Sectional View of Bowser Filter Section Assembled.



No. 2—Filter Disc With Dirt Filtered From Oil.

The pictures shown illustrate the Bowser Filter Section as used in the Bowser Oil Filter.

No. 1 shows the Filter Section assembled, ready for use. No. 2 shows one of the Filter discs with dirt that the Filter has collected from used oil. This pile of dirt is about 6" in diameter and from 2" to 3" high.

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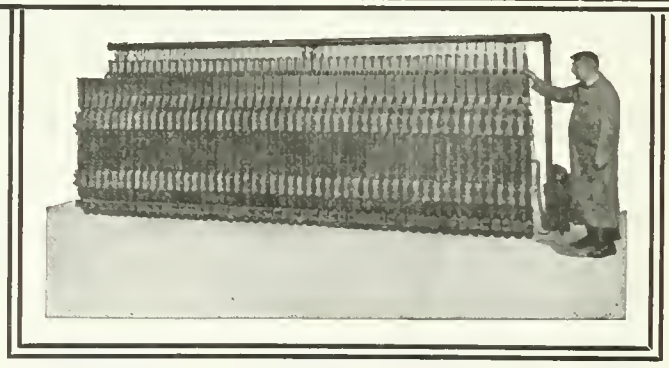

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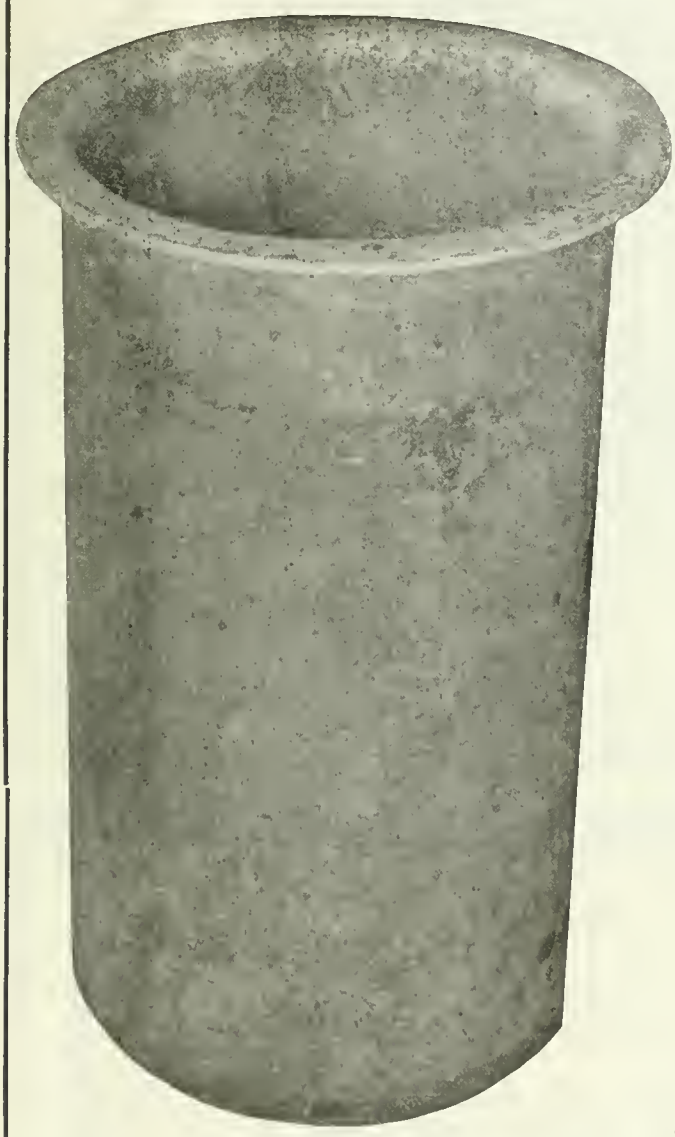

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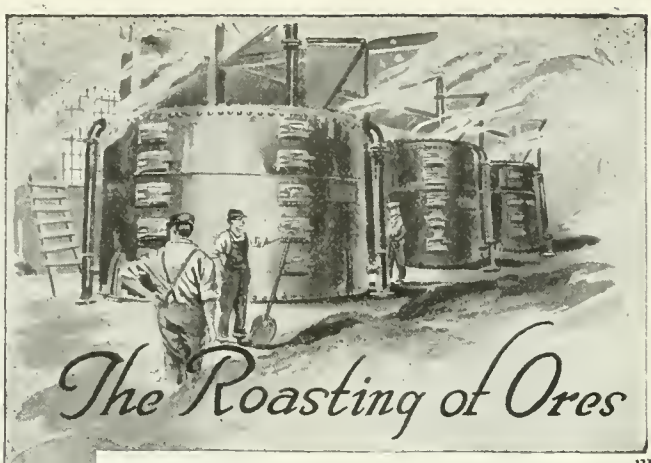

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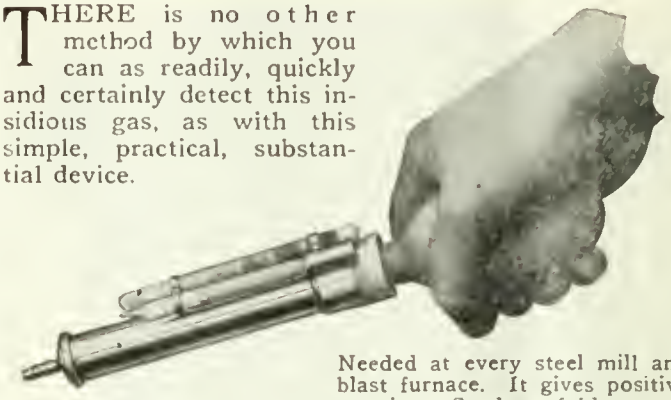

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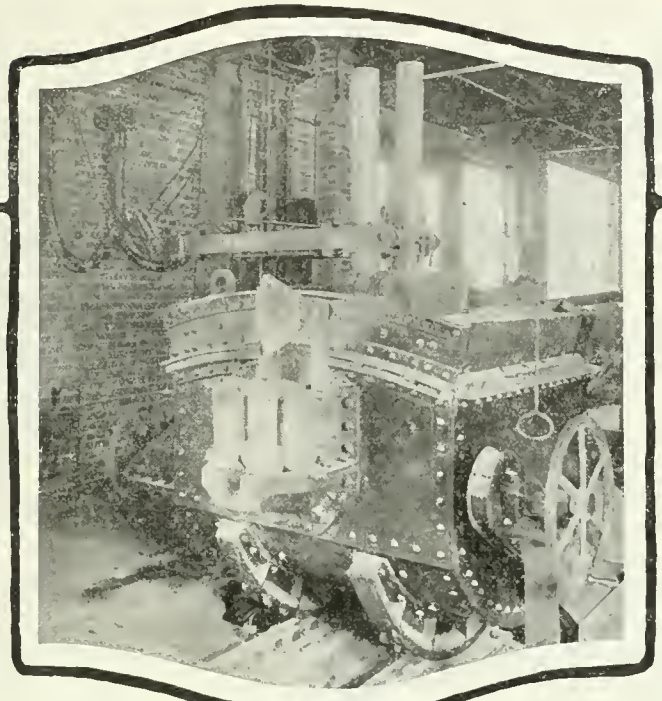

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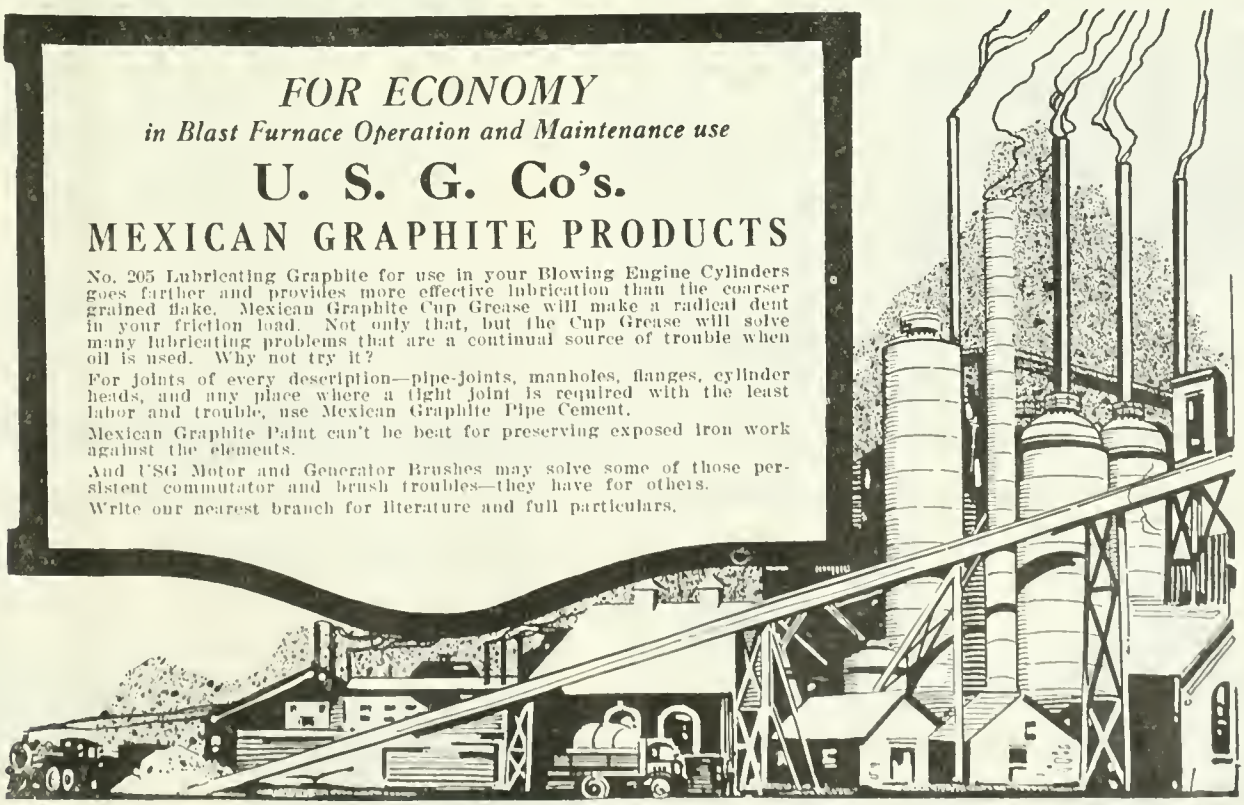

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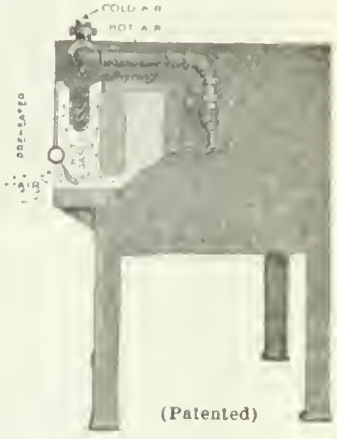

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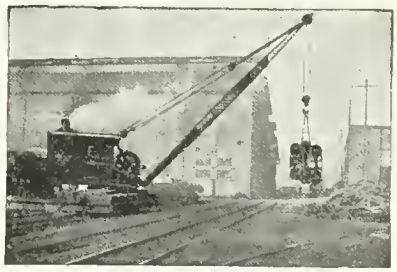

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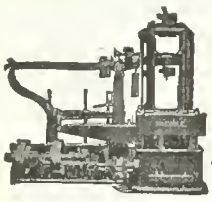

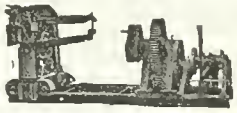

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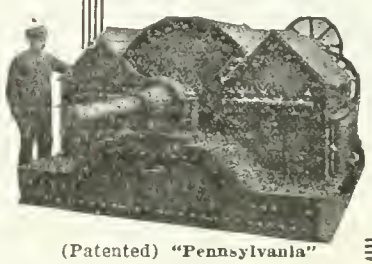

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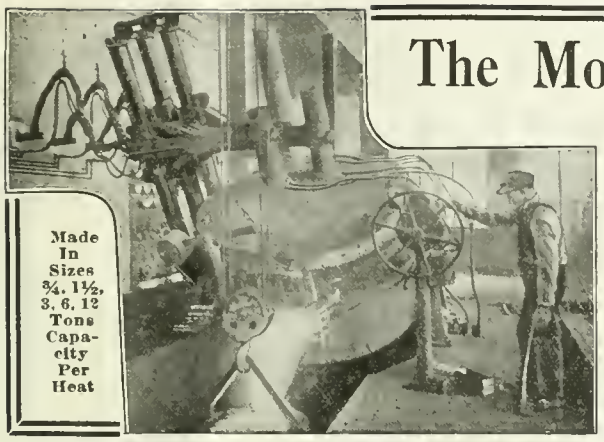

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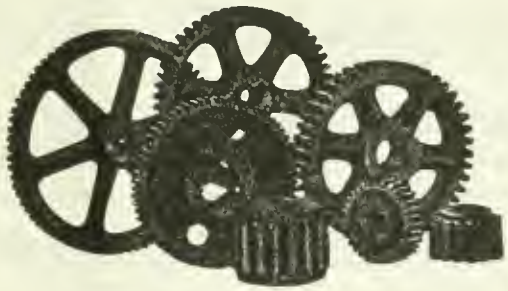

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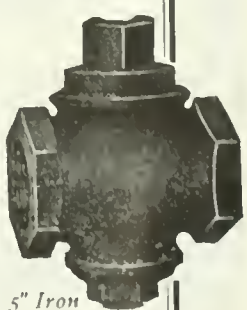

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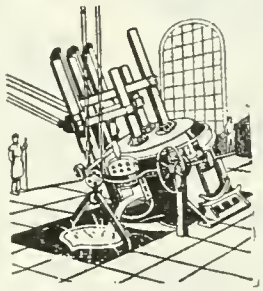

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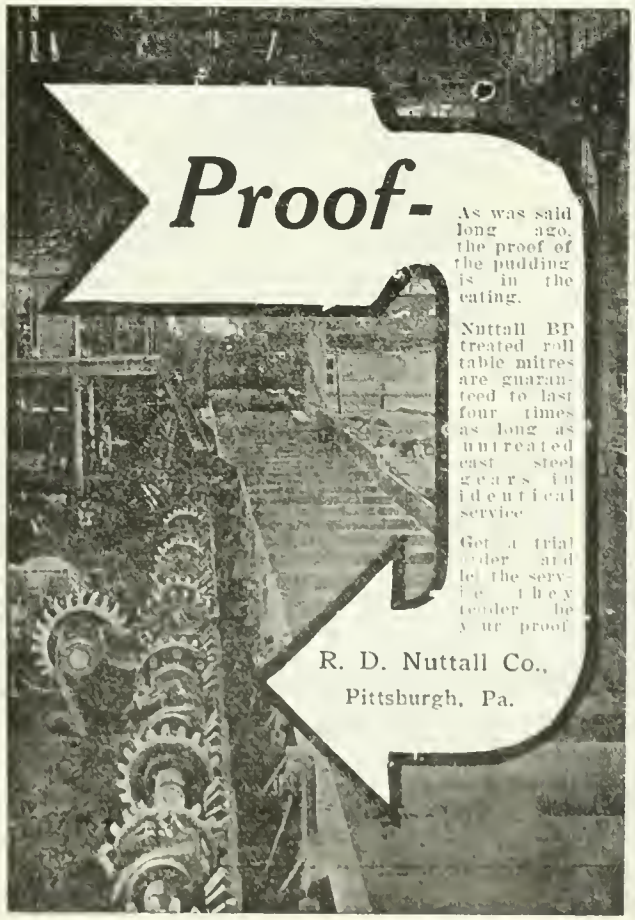
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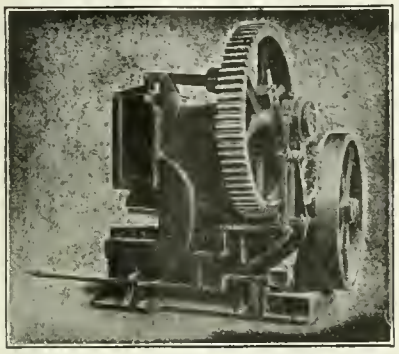

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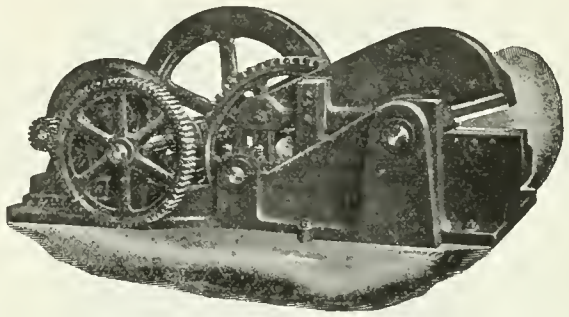

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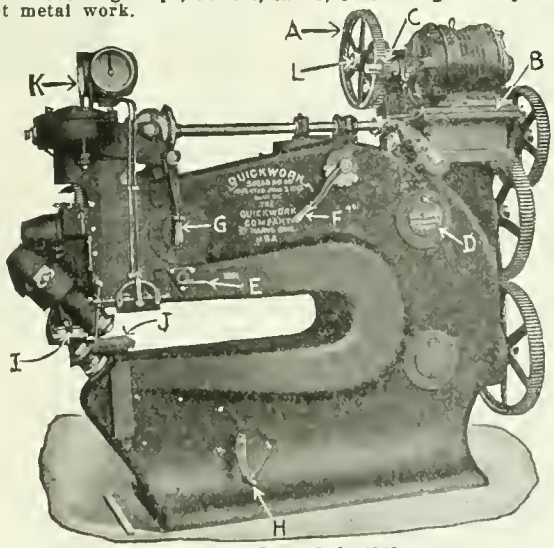

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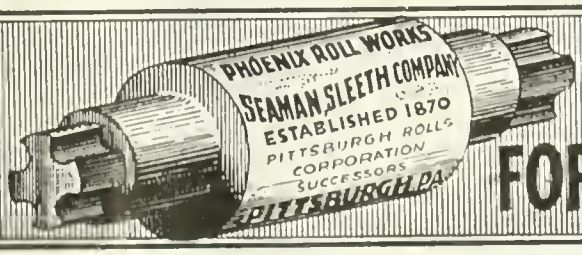

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United Smelting & Aluminum Co.

Bearings—Roller.
American Roller Bearing Co.
Hyatt Roller Bearing Co.

Belting—Chains.
Chain Belt Co.
Link-Belt Company.
Morse Chain Co.

Belting—Silent Chain.
Link-Belt Company.
Morse Chain Co.

Benches—Draw Wire, Rivet and Bolt Works.
Morgan Construction Co.

Benzol Recovery Plants.
The Koppers Co.

Billets—Steel.
Brier Hill Steel Co.

Blast Furnaces.
McKee Co., Arthur G.
Meehan Boiler & Constr. Co.

Blast Gates.
Rockwell, W. S. Co.
Quigley Furnace Specialties Co.

Blast Furnace Fireproofing.
King-Karbo Products Corp.

"Blaw" Buckets.
Blaw-Knox Co.

Blocks—Die.
Heppenstall Forge & Knife Co.

Blowers—Soot.
Diamond Power Specialty Co.

Blowers—Turbine.
Ingersoll-Rand Co.

Blowing Engine Heads.
Hope Eng. & Supply Co.

Blowing Engines.
Hope Eng. & Supply Co.

Boilers.
Babcock & Wilcox Co., The.
Ladd Co., Geo. T.
Meehan Boiler & Construction Co.
Wickes Boiler Co

Boiler Feed Water Meters.
Yarnall-Waring Co.

Boiler Insulation.
Botfield Specialties Co.
Quigley Furnace Specialties Co
Cellite Products Co.

Boiler Metal Treatment.
The Jos. W. Hays Corp.

Boiler Setting Compound "Hestix."
The Jos. W. Hays Corp.

Boiler Settings.
Clinton Metallic Paint Co.
Freeman Fire Brick Co.
Ladd Co., Geo. T.
Hydraulic Press Brick Co.
Quigley Furnace Specialties Co.

Boiler Skimmers.
Yarnall-Waring Co.

Boiler Tubes.
American Tube & Pipe Bend. Co.
Youngstown Sheet & Tube Co.

Boilers—Water Tube.
Babcock & Wilcox Co., The.
Ladd Co., Geo. T.
Meehan Boiler & Construction Co.
Wickes Boiler Co.

Bolts.
Oliver Iron & Steel Co.

Bonding Material Fire Brick Cement.
Clinton Metallic Paint Co.
Quigley Furnace Specialties Co.

Boxes — Annealing Furnace and Oven.
American Steel Foundries.
Birdsboro Steel Fdy. & Mch. Co.
Blaw-Knox Co.
Meehan Boiler & Construction Co.
Mesta Machine Co.
Quigley Furnace Specialties Co.
United Engineering & Fdy. Co.

Box Car Loaders.
Link-Belt Company.

Brass Cocks.
Chapman Valve Mfg. Co., The

Bradford Breakers.
Pennsylvania Crusher Co.

Brakes—Electric, Magnetic, Crane.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.

Brakes—Disc.
Cutler-Hammer Mfg. Co.
Medart Patent Pulley Co.

Brakes—Motor Operated.
Cutler-Hammer Mfg. Co.

Brazing—Metal.
Pittsburgh Metal Brazing Co.

Brick—Chrome, Magnesia, Silica.
Amer. Enameled Brick & Tile Co.
American Refractories Co.
Bessemer Brick Co.
Harbison-Walker Ref. Co.
Mt. Union Refractories Co.
Mutton Hollow Fire Brick Co.
Pyro Clay Products Co.
Taylor, Chas., The Sons Co.

Brick—Blast Furnace.
Amer. Enameled Brick & Tile Co.
American Refractories Co.
Ashland Fire Brick Co.
Bessemer Brick Co.
Brighton Fire Brick Co.
Clearfield Fire Brick Co.
Dover Fire Brick Co.
Eureka Fire Brick Works.
Harbison-Walker Ref. Co.
Hydraulic Press Brick Co.
Kier Fire Brick Co.
Mt. Union Refractories Co.
Mutton Hollow Fire Brick Co.
Paterson Fire Brick Co.
Pyro Clay Products Co.
Solsson Fire Brick Co., Jos.

Brick—Boiler Settings.
Amer. Enameled Brick & Tile Co.
American Refractories Co.
Ashland Fire Brick Co.
Bessemer Brick Co.
Brighton Fire Brick Co.
Clearfield Fire Brick Co.
Dover Fire Brick Co.
Harbison-Walker Ref. Co.
Hydraulic Press Brick Co.
Kier Fire Brick Co.
Mt. Union Refractories Co.
Mutton Hollow Fire Brick Co.
Paterson Fire Brick Co.
Pyro Clay Products Co.
Solsson Fire Brick Co., Jos.
Taylor, Chas., The Sons Co.

Brick—Fire.
Amer. Enameled Brick & Tile Co.
American Refractories Co.
Ashland Fire Brick Co.
Bessemer Brick Co.
Brighton Fire Brick Co.
Clearfield Fire Brick Co.
Crescent Refractories Co.
Dover Fire Brick Co.
Eureka Fire Brick Works.
Harbison-Walker Ref. Co.
Hydraulic Press Brick Co.
Kier Fire Brick Co.
Manown Mfg Co.
Mt. Union Refractories Co.
Mutton Hollow Fire Brick Co.
Pyro Clay Products Co.
Solsson Fire Brick Co., Jos.
Taylor, Chas., The Sons Co.

Brick—Heat Insulating.
Amer. Enameled Brick & Tile Co.
Bessemer Brick Co.
Cellite Products Co.
Eureka Fire Brick Works.
Mt. Union Refractories Co.
Mutton Hollow Fire Brick Co.
Pyro Clay Products Co.
Quigley Furnace Specialties Co.
Taylor, Chas., The Sons Co.

Brick—Locomotive Fire.
Amer. Enameled Brick & Tile Co.
Bessemer Brick Co.
Clearfield Fire Brick Co.
Dover Fire Brick Co.
Harbison-Walker Ref. Co.
Hydraulic Press Brick Co.
Mt. Union Refractories Co.
Mutton Hollow Fire Brick Co.
Pyro Clay Products Co.
Taylor, Chas., The Sons Co.

Brick—Nozzles, Sleeves and Runner.
Amer. Enameled Brick & Tile Co.
Bessemer Brick Co.
Manown Mfg Co.
Mt. Union Refractories Co.
Mutton Hollow Fire Brick Co.
Pyro Clay Products Co.

Boiler Feed Purification.
Scaife, Wm. B. & Sons Co.

Boxes—Case Hardening and Carbonizers.
Quigley Furnace Specialties Co.

Bridges and Structural Work.
Kratzer & Co., W. N.
Meehan Boiler & Construction Co.
Mt. Vernon Bridge Co.

Brushes—Carbon, Graphite, Motor and Generator.
United States Graphite Co., The.

Bronze Gate Valves.
Chapman Valve Mfg. Co., The.

Buckets—Clam Shell, Grab or Orange Peel for Coal and Ore.
Blaw-Knox Co.
Browning & Co., Victor R.
Edgar E. Brosius.
Link-Belt Company.
Penn Foundry & Mfg. Co.

Buckets—Elevator.
Link-Belt Company.

Buckets—Foundry and Construction, Mixing and Bottom Dumps.
Biehl Iron Works, Inc., The.

Buckstays—O. H.
Blair Engineering Co.
Blaw-Knox Co.
National Roll & Fdy. Co.

Buildings.
Kratzer & Co., W. N.
Mt. Vernon Bridge Co.

Bulkheads—O. H.
Blair Engineering Co.
Blaw-Knox Co.
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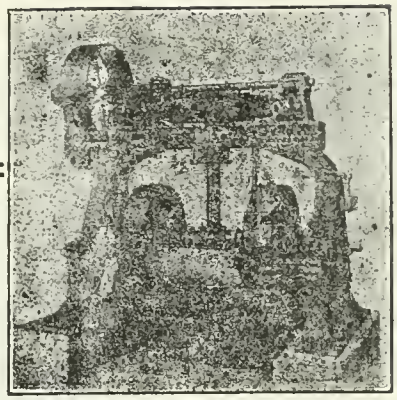

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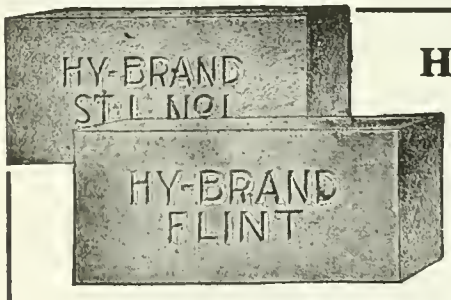

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Bulldozers.
Garrison Foundry Co., A.
Morgan Construction Co.

Burners—Gas and Oil.
Rockwell Co., W. S.
Schutte & Koerting Co.

Burners—Powdered Coal.
Quigley Furnace Specialties Co.
Stroud, E. H. & Co.

By-Product Coke and Gas Oven Plants.
Koppers Co., The.

Cages—Hoisting.
R. H. Beaumont Co.
Link-Belt Company.

Calorizing.
Calorizing Corp. of America.

Calorized Pyrometer Protection Tubes.
Calorizing Corp. of America.

Carbon Brushes.
Speer Carbon Co.

Carbon Dioxide Recorders.
The Jos. W. Hays Corp.

Carbon Monoxide Analyzers.
The Jos. W. Hays Corp.

Cars—Dump.
R. H. Beaumont Co.
Biehl Iron Works.
Clark Car Co.
Easton Car & Construction Co.
Link-Belt Company.
Penn Foundry & Mfg. Co.
Treadwell Engineering Co.
Whiting Foundry Equipment Co.
Youngstown Fdy. & Mch. Co.

Cars—Extensive Side Dump.
Clark Car Co.

Cars—Forging and Charging Box.
Easton Car & Construction Co.
Treadwell Engineering Co.

Cars—Hot Metal.
Blaw-Knox Co.
Easton Car & Construction Co.
Meehan Boiler & Construction Co.
Treadwell Engineering Co.
Youngstown Fdy. & Mch. Co.

Cars—Ingot—Slag—Billet.
Birdsboro Steel Fdy. & Mch. Co.
Easton Car & Construction Co.
Treadwell Engineering Co.

Cars—Industrial.
Biehl Iron Works, Inc.
Easton Car & Construction Co.
Penn Foundry & Mfg. Co.
Treadwell Engineering Co.
Whiting Foundry Equipment Co.
Youngstown Fdy. & Mch. Co.

Cars — Ingot and Open Hearth Charging.
Treadwell Engineering Co.

Cars—Ladle Transfer.
Easton Car & Construction Co.
Treadwell Engineering Co.
Youngstown Fdy. & Mch. Co.

Cars—Storage Battery.
Stroud, E. H. & Co.

Case Hardening Boxes.
Quigley Furnace Specialties Co.

Case Hardening Compound.
Quigley Furnace Specialties Co.

Castings—Annealed, Semi-Steel.
McLain's System, Inc.

Castings.
American Steel Foundries.
Birdsboro Steel Fdy. & Mch. Co.
Camden Iron Works.
Chambersburg Engineering Co.
Duquesne Steel Foundry Co.

Coke Breeze.
Combustion Eng. Corp.

Garrison Foundry Co., A.
Link-Belt Company.
Mesta Machine Co.
National Roll & Foundry Co.
Otis Steel Co., The.
Penn Foundry & Mfg. Co.
Phillips & McLaren Co.
Standard Engineering Co.
Treadwell Engineering Co.
United Eng. & Fdy. Co.
Valley Mould & Iron Corp.
Wheeling Mold & Foundry Co.

Castings—Aluminum.
Penn Foundry & Mfg. Co.

Castings—Brass and Bronze.
Acme Brass Foundry Co.
Damascus Bronze Co.
Keystone Bronze Co.
Mesta Machine Co.
Morgan Engineering Co.

Castings—Chill.
McLain's Syatem, Inc.

Castings—Electric Steel.
American Steel Foundries.
Birdsboro Steel Fdy. & Mch. Co.
Treadwell Engineering Co.
Wheeling Mold & Fondry Co.

Castings—Electric Process.
Treadwell Engineering Co.

Cast Steel Gate Valves.
Chapmnn Valve Mfg. Co.. The.

Castings—Gear.
American Steel Foundries.
Birdsboro Steel Fdy. & Mch. Co.
Chambersburg Engineering Co.
Duquesne Steel Foundy Co.
Garrison Foundry Co., A.
Link-Belt Company.
Mackintosh, Hemphill & Co.
Mesta Machine Co.
Pittsburgh Iron & Steel Fdys. Co.
Standard Engineering Co.
Taylor-Wilson Mfg. Co.
Treadwell Engineering Co.
United Engineering & Fdy. Co.
Wheeling Mold & Foundry Co.

Castings—Semi-Steel.
Camden Iron Works.
Duquesne Steel Foundry Co.
McLain's System, Inc.

Castings—Gray Iron and Steel.
Garrison Foundry Co., A .
Link-Belt Company.
Morse Chain Co.
Otis Steel Co., The.
Penn Foundry & Mfg. Co.
Nuttall & Co., R. D.
Taylor-Wilson Mfg. Co.
Treadwell Engineering Co.

Castors—Plate Mill.
Edw. F. Terry Mfg. Co.
Treadwell Engineering Co

Cells—Generators, Hydrogen and Oxygen.
International Oxygen Co.

Cement—Fire Brick.
American Refractories Co.
Botfield Specialties Co.
Clinton Metallic Paint Co.
Crescent Refractories Co.
Quigley Furnace Specialties Co.

Cement—Furnace—High Temperature.
Clinton Metallic Paint Co.
Quigley Furnace Specialties Co.

Cement—Pipe.
United States Graphite Co., The.

Central Station Equipment.
Allis-Chalmers Mfg. Co.
Morgan Construction Co.
Smith Gas Engineering Co.

Chains—Agricultural.
Link-Belt Co.
Morse Chain Co.

Chains—Automobile, Engine.
Link-Belt Co.
Morse Chain Co.

Chain Blocks.
Morse Chain Co

Chains—Bicycle (Twin Roller)
Morse Chain Co.

Chain Grates.
Hagan, Geo. J. Co.

Chains.
Link-Belt Company.

Chain—Power Transmission.
Chain Belt Co.
Link-Belt Company.
Morse Chain Co.

Chain Drives.
Chain Belt Co.
Link-Belt Company.
Morse Chain Co.

Chains—Sprocket Wheel.
Link-Belt Co.
Morse Chain Co.

Chains—Silent.
Link-Belt Co.
Morse Chain Co.

Channels.
Kratzer & Co., W. N.

Charcoal Iron.
American Tube & Pipe Bend. Co.

Charging Buggies.
Treadwell Engineering Co.

Check Valves.
Chapman Valve Mfg. Co., The.

Chimneys—Steel.
Kratzer & Co., W. N.

Chrome.
Harbison-Walker Refractories Co.

Chrome Brick.
American Refractories Co.

Chromium.
Metal & Thermit Corp.

Circulating Systems for Lubricating Oil.
Bowser & Co., Inc., S. F.

Clamps—Flanging.
Chambersburg Engineering Co.
Niles-Bement Pond Co.
Yarnall-Waring Co.

Cleaners—Boiler Tube.
Pierce, William B., The Co.

Clutches—Magnetic.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.

Coal.
Combustion Eng. Corp.
McKeefrey & Co.
Pittsburgh Coal Co.
Stewart Iron Co.
Matthew Addy Co., The.

Coal and Ash Handling Machinery.
Link-Belt Company.
Edw. F. Terry Mfg. Co.

Coal and Ore Handling Machinery.
Link-Belt Company.

Coal Storage and Rehandling Machines.
Link-Belt Company.

Coal Pulverizers.
Fuller Engineering Co.

Coal Crushers.
Link-Belt Co.
Orton & Steinbrenner Co.

Cobalt—98%.
Metal & Thermit Corp.

Coal—Plants for Powdering.
Blaw-Knox Co.
Bonnot Co., The.
Fuller Engineering Co.
Fuller-Lehigh Co.
Quigley Furnace Specialties Co.

Coal Tipples and Trestles.
Link-Belt Company.
Mt. Vernon Bridge Co.

Coal Washers.
Link-Belt Company.

Cocks—Tuyere.
McCarthy, Felix.
Homestead Valve Mfg. Co.

Coils and Bends—Pipe.
Pittsburgh Piping & Equip. Co.

Coke.
McKeefrey & Co.
Stewart Iron Co.

Coke Conveyors and Elevators.
R. H. Beaumont Co.
Link-Belt Company.

Coke Ovens — By-Product—Cross Regenerators.
Hydraulic Press Brick Co.
Koppers Co., The.

Collectors, Gas.
The Jos. W. Hays Corp.

Cooling Ponds.
Yarnall-Waring Co.

Cooling Systems.
Yarnall-Waring Co.

Columns.
Kratzer & Co., W. N.
Meehan Boiler & Construction Co.

Combustion (CO_2) Recorders.
The Jos. W. Hays Corp.

Compound—Boiler.
United States Graphite Co., The

Compressed Air Locomotives.
Porter Co., H. K.

Compressors—Air.
Allis-Chalmers Mfg. Co.
Blaw-Knox Co.
De Laval Steam Turbine Co.
General Electric Co.
Hope Eng. & Supply Co.
Ingersoll-Rand Co.
Mesta Machine Co.

Concrete — Steel Forms for Construction.
Blaw-Knox Co.

Complete Foundry Plants.
Whiting Fdry. & Equip. Co

Compressors—Oxygen and Hydrogen Gas.
International Oxygen Co.

Concrete Construction.
McKee, Arthur G. & Co.

Concrete Machinery.
Standard Scale & Supply Co.

Condensers.
International Oxygen Co.

Condensers — Barometric, Surface Jet.
Ingersoll-Rand Co.
Mesta Machine Co.
Westinghouse Electric & Mfg. Co.

Condensers—Low Level Set.
Ingersoll-Rand Co.

Condensers—Surface.
Ingersoll-Rand Co.

Conduits—Elbow.
American Tube & Pipe Bending Co.

Conduits—Electrical.
Youngstown Sheet & Tube Co.

Connectors—Frankel Solderless.
Westinghouse Electric & Mfg. Co.

Constructing Engineers.
Westinghouse, Church, Kerr & Co., Inc.

Construction—Blast Furnace.
Blaw-Knox Co.
Freyn, Brassert & Co.
Laughlin & Sons Co., Alex.
Meehan Boiler & Construction Co.
McClure, G. W. & Son Co.
McKee, Arthur G. Co.
Mt. Vernon Bridge Co.
Smythe & Co., S. R.

Construction—Gas Works.
Blaw-Knox Co.
Morgan Construction Co.
McKee, Arthur G. Co.
Smith Gas Engineering Co.

Construction—Plate.
Blaw-Knox Co.
Meehan Boiler & Construction Co.
Mt. Vernon Bridge Co.

Construction—Structural Iron, Steel
Blaw-Knox Co.
Kratzer & Co., W. N.
Meehan Boiler & Construction Co.
Mt. Vernon Bridge Co.

Construction—Wire Work.
Kratzer & Co., W. N.

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Meade, Richard K. Co.

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Browning & Co., Victor R.

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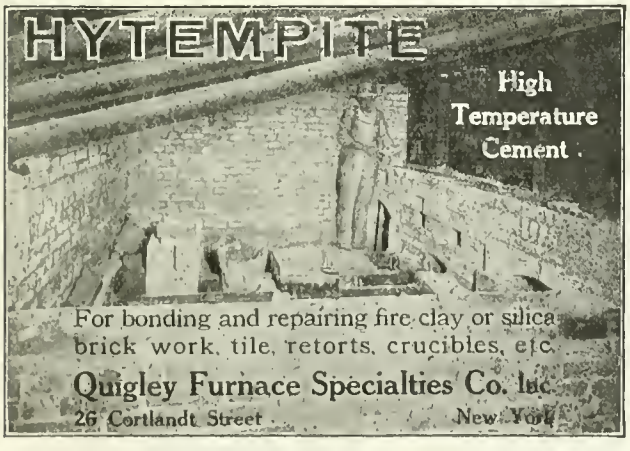
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Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.

Controllers—Enclosed Drum Type for Cranes.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.

Controllers—Electric, for Steel Mill Machinery.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.

Controllers — Manual, Automatic, Machine Tool, Crane, Coal and Ore Bridges.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.

Conveyors—Billet.
Link-Belt Company.
Treadwell Eng. Co.

Conveying & Elevating Machinery.
R. H. Beaumont Co.
Link-Belt Co.

Conveyors — Belt, Coal, Chain, Flight, Apron, Etc.
Link-Belt Company.

Cooling Beds.
Treadwell Engineering Co.

Cooling Plates.
Blaw-Knox Co.

Cooling Ponds.
Spray Engineering Co.

Cooling Systems—Air.
Badger, E. B., & Sons Co.
Spray Engineering Co.

Cooling Towers.
Badger, E. B., & Sons Co.
Spray Engineering Co.

Copper Tubing.
Wheeler Condenser & Eng. Co.

Core Ovens.
Whiting Foundry Equipment Co.

Coupling Boxes.
American Steel Foundries Co.
Garrison Foundry Co., A.
Mesta Machine Co.
National Roll & Foundry Co.
Standard Engineering Co.
Wheeling Mold & Foundry Co.

Couplings—Flexible.
Smith & Serrell.

Couplings—Magnetic.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.

Couplings—Pipe.
Youngstown Sheet & Tube Co.

Couplings—Shaft.
Link-Belt Company.
Morse Chain Co.
Smith & Serrell.

Couplings—Rigid.
Smith & Serrell.

Couplings—Compression Shaft.
W. H. Nicholson & Co.

Coverings for Cold Pipes.
Quigley Furnace Specialties Co.

Coverings for Pipes and Boilers.
Celite Products Co.
Quigley Furnace Specialties Co.

Cranes—Charging.
Alliance Machine Co.
Champion Engineering Co.
Morgan Engineering Co.
Northern Engineering Works.
Niles-Bement-Pond Co.

Cranes—Electric Traveling, Gantry and Grab Bucket.
Alliance Machine Co.
Browning & Co., Victor R.
Champion Engineering Co.
Link-Belt Co.
Morgan Engineering Co.
Niles-Bement-Pond Co.
Northern Engineering Works.
Toledo Bridge & Crane Co.
Whiting Fdry. & Equipment Co.

Cranes—Gantry.
Link-Belt Co.
Northern Engineering Works.
Whiting Fdry. Equipment Co.

Cranes—Hand.
Whiting Foundry Equipment Co.

Cranes—Jib and Pillar.
Northern Engineering Works.
Whiting Foundry Equipment Co.

Cranes—Coal and Ash Handling.
Link-Belt Co.
Northern Engineering Works.
Edw. F. Terry Mfg. Co.
Toledo Bridge & Crane Co.
Whiting Foundry Equipment Co.

Cranes—Locomotive.
Browning & Co., Victor R.
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Cranes—Pillar.
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Cranes—Pneumatic.
Northern Engineering Works.
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Cranes—Slag Breaking and Handling.
Northern Engineering Works.
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Cranes—Transfer.
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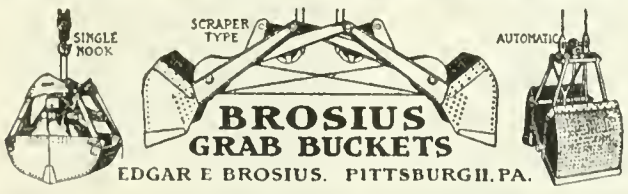

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Clearfield Fire Brick Co.
Dover Fire Brick Co.
Harbison-Walker Ref. Co.
Kier Fire Brick Co.
Manown Mfg. Co.
Pyro Clay Products Co.
Mutton Hollow Fire Brick Co.
Quigley Furnace Specialties Co.
Soisson, Jos., Fire Brick Co.
Taylor, Chas. P.

Liquid Level.
Bristol Co.

Lubricants.
Gulf Refining Co.

Loaders — Wagon Coal, Crushed Stone, Rock, Ore, Ashes, Etc.
Link-Belt Company.

Locomotives and Special Cranes.
Orton & Steinbrenner Co.
U. S. Crane Co.

Locomotives—Electric.
Atlas Car & Mfg. Co.
Baldwin Locomotive Works.
General Electric Co.
Vulcan Iron Works
Westinghouse Elec. & Mfg. Co.

Locomotives — Steam, Compressed Air, Storage Steam.
Porter, H. K. Co.
Baldwin Locomotive Works.
Vulcan Iron Works.

Locomotives—Storage Battery.
Atlas Car & Mfg. Co.

Lubricants—Gear, Wire Rope, Etc.
Gulf Refining Co.
Keystone Lubricating Co.
Texas Co.
Ironsides Co., The.
United States Graphite Co., The

Machinery—Clay.
Phillips & McLaren Co.

Machinery—Hydraulic.
Allis-Chalmers Mfg. Co.
Birdsboro Steel Fdy. & Mch. Co.
Chamberebure Engineering Co.
Mesta Machine Co.
Niles-Bement-Pond Co.
Treadwell Engineering Co.
United Engineering & Fdy. Co.

Machinery—Milling.
Cutler-Hammer Mfg. Co.
Niles-Bement-Pond Co.

Machinery—Rolling Mill.
Birdsboro Steel Fdy. & Mch. Co.
Garrison, A., Foundry Co.
Mackintosh, Hemphill & Co.
Mesta Machine Co.
Morgan Construction Co.
Morgan Engineering Co.
National Roll & Foundry Co.
Phillips & McLaren Co.
Pittsburgh Rolls Corporation.
Standard Engineering Co.
Treadwell Engineering Co.
United Engineering & Fdy. Co.
Wheeling Mold & Foundry Co.
Woodard Machine Co.
Youngstown Fdy. & Mch. Co.

Machinery—Transmission (Power).
Link-Belt Co.
Morse Chain Co.

Machinery—Special.
Cutler-Hammer Mfg. Co.
Garrison, A., Foundry Co.
Niles-Bement-Pond Co.
Southwark Foundry & Mch. Co.
Treadwell Engineering Co.
Simonds Mfg. Co., The.
United Engineering & Fdy. Co.
Woodard Machine Co.

Machinery—Tin Plate.
Garrison, A., Foundry Co.
Mesta Machine Co.
Northern Engineering Works.

Machinery—Transmitting.
Link-Belt Company.
Mesta Machine Co.
Morse Chain Co.

Machinery—Wire Drawing, Wire and Rivet Works.
Morgan Construction Co.
Shuster Co., F. B.

Machinery and Supplies—Mining.
Meehan Boiler & Constr'n. Co.

Machinery—Wire Mill.
Morgan Construction Co.

Machinery—Tin Plate.
Garrison Foundry Co., A.
Mesta Machine Co.
Northern Engineering Works.

Machines—Straightening.
Medart Patent Pulley Co.
Morgan Construction Co.
Niles-Bement-Pond Co.
Shuster Co., F. B.

Machines—Testing.
Riehle Brothers Co.

Machinists.
Pittsburgh Valve, Fdy. & Con. Co.

Magnesia Brick.
American Refractories Co.

Magnesite.
American Refractories Co.

Magnetic Clutches, Brakes, Separators.
Cutler-Hammer Mfg. Co.

Magnets—Electric Lifting.
Browning Co.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
Ohio Electric & Controller Co.

Manganese—Pure.
Metal & Thermit Corp.

Manganese—Copper.
Metal & Thermit Corp.

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Oliver Iron & Steel Co.

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Diamond Power Specialties Co.

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Keystone Bronze Co.
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Metallic Packing.
Crane Packing Co.

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Republic Flow Meters Co.

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Cutler-Hammer Mfg. Co.
Uehling Instrument Co.

Meters for Oil—Kerosene, Gasoline.
Bowser, S. F. & Co., Inc.

Meters—Recording.
Bristol Co., The.
Brown Instrument Co.
Leeds & Northrup Co.
Yarnall-Waring Co.

Metals—Non-Ferrous.
Allen, A., & Son.
Damascus Bronze Co.
Metal & Thermit Corp.

Mill Brasses.
Acme Brass Foundry Co.

Mill Bearings—Roller.
Hyatt Roller Bearing Co.

Mills—Continuous Rolling.
Garrison, A., Foundry Co.
Mackintosh, Hemphill & Co.
Mesta Machine Co.
Morgan Construction Co.
Pittsburgh Iron & Steel Fdys. Co.
Standard Eng. Co.
Treadwell Engineering Co.
United Eng. & Foundry Co.

Mill Drives.
Falk Co., The.
Fawcus Machine Co.

Mills—Blooming, Universal, Plate, Sheet, Tin and Bar.
Treadwell Engineering Co.

Mills—Wire, Complete Equipment.
Morgan Construction Co.

Mineral Seal.
Sloan & Zook.

Mixers—"Blaw."
Blaw-Knox Co.

Molds—Ingot.
Valley Mould & Iron Co.
Penn Mold & Mfg. Co.
Wheeling Mold & Foundry Co.

Molybdenum.
Metal & Thermit Corp.

Monorail Systems Electric.
Link-Belt Company.

Monorails—Overhead.
Link-Belt Company.
Niles-Bement-Pond Co.
Whiting Foundry Equipment Co.

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Allis-Chalmers Mfg. Co.
General Electric Co.
Westinghouse Electric & Mfg. Co.

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Cutler-Hammer Mfg. Co.

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McCarthy, Felix.

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Youngstown Sheet & Tube Co.

Neutrals.
Sloan & Zook.

Nodulizing Kilns.
Vulcan Iron Works.

Nozzles—Spray.
Schutte & Koerting Co.
Spray Engineering Co.
Yarnall-Waring Co.

Oil Burners—Fan Tail Type.
Foerst, John Sons & Co.

Oils—Engine.
Gulf Refining Co.
Ironsides Co.
Keystone Lubricating Co.
Texas Co.

Oil Engines.
Ingersoll-Rand Co.

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Gulf Refining Co.

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Green Tweed Co.

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Clinton Metallic Paint Co.
United States Graphite Co., The

Patents.
Siggers, E. G.
Whitaker, Norman T.

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Blair Engineering Co.
Blaw-Knox Co.
National Roll & Fdy. Co.
Treadwell Construction Co.

Picks.
Oliver Iron & Steel Co.

Pickling Tables.
Link-Belt Company.

Pig Iron.
McKeefrey & Co.
Stewart Iron Co.
Tod-Stambaugh Co.

Pile Drivers.
Vulcan Iron Works.

Pinions—Mill.
American Steel Foundries Co.
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Mackintosh, Hemphill & Co.
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Standard Engineering Co.
Otis Steel Co., The.
Simonds Mfg. Co.
United Eng. & Foundry Co.
Wheeling Mold & Foundry Co.
Woodard Machine Co.

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Pittsburgh Piping & Equip. Co.
Youngstown Sheet & Tube Co.

Pipe—Bends and Coils.
American Tube & Pipe Bending Co
Pittsburgh Piping & Equip. Co.
Taylor-Wilson Mfg. Co.

Pipe—Riveted Steel.
Blaw-Knox Co.
Meehan Boiler & Constr'n. Co.

Pipe—Wrought Iron.
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Youngstown Sheet & Tube Co.

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Heppenstall Forge Co.

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Independent Pneumatic Tool Co.

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Canton Foundry & Machine Co.

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Easton Car & Construction Co

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Blair Engineering Co.
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Knox Pressed & Welded Steel Co.
National Roll & Fdy. Co.

Pots, Annealing—Forge and Hammer.
Kellogg, M. W. Co., The.
Quigley Furnace Specialties Co.

Pots, Annealing—Lap Welded.
Kellogg, M. W. Co., The.

Pots—Cinder Slag.
Treadwell Engineering Co.

Power House Conveyors.
Link-Belt Company.

Power Plants.
McKee, Arthur G. & Co.

Power Transmitting Machinery.
Link-Belt Co.
Treadwell Engineering Co.

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American Industrial Eng. Co.
Fuller Engineering Co.
Fuller-Lehigh Co.
Quigley Furnace Specialties Co.
Stroud, E. H. & Co.

Powdered Coal Plants—Complete.
Fuller Engineering Co.
Quigley Furnace Specialties Co.

Presses—Forging.
Camden Iron Works.
Canton Foundry & Machine Co.
Chambersburg Engineering Co.
Garrison, A., Foundry Co.
Mesta Machine Co.
Morgan Engineering Co.
Niles-Bement-Pond Co.
United Engineering & Fdy. Co.

Presses—Hydraulic.
Birdsboro Steel Fdy. & Mch. Co.
Camden Iron Works.
Canton Foundry & Machine Co.
Chambersburg Engineering Co.
Garrison, A., Foundry Co.
Mesta Machine Co.
Niles-Bement-Pond Co.
United Engineering & Fdy. Co
Vulcan Iron Works.

Presses—Rail Straightening.
Canton Foundry & Machine Co.
Garrison, A., Foundry Co.
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Homestead Valve & Mfg. Co.
Spray Engineering Co.
Yarnall-Waring Co.

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Bristol Co.

Producers—Gas Automatic.
Wood, R. D. & Co.

Producers—Gas.
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Chapman Eng. Co.
Laughlin, Alex. & Co.
Morgan Construction Co.
Smith Gas Engineering Co., The
S. R. Smythe Co., The.
Wood, R. D. & Co.

Pulleys and Clutches.
Link-Belt Company.
Medart Patent Pulley Co.
Mesta Machine Co.
Morse Chain Co.

Pulverizers.
American Industrial Eng. Co.
Fuller Engineering Co.
Fuller-Lehigh Co.
Pennsylvania Crusher Co.
Quigley Furnace Specialties Co.
Stroud, E. H. & Co.

Pulverized Coal Equipment.
American Industrial Eng. Co.
Bonnot Co., The.
Combustion Eng. Co.
Fuller Engineering Co.
Fuller-Lehigh Co.
Meade, Richard K. Co
Quigley Furnace Specialties Co.
Stroud, E. H. & Co.

Pumps—Air.
Ingersoll-Rand Co.

Pumps.
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Mesta Machine Co.
Richardson-Prenix Co.

Pumps—Centrifugal.
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DeLaval Steam Turbine Co.

Pumps—Electric.
Aldrich Pump Co.
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Bowser, S. F. & Co., Inc.

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Meehan Boiler & Constr. Co.
Rivet Cutting Gun Co.

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Mackintosh-Hemphill Co.

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Treadwell Engineering Co.

Rods—Piston.
Heppenstall Forge & Knife Co.
Heppenstall Forge Co.

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Pennsylvania Crusher Co.
Stroud, E. H. & Co.

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Mackintosh, Hemphill & Co.
Mesta Machine Co.
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Pittsburgh Iron & Steel Fdys. Co.
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Canton Steel Foundry Co., The.
United Engineering & Fdy. Co.
Wheeling Mold & Foundry Co.
Youngstown Fdy. & Mch. Co.

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Keystone Bronze Co.

Roll Lathes.
Standard Engineering Co.

Roll Neck Lubricant.
Ironsides Co., The.

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Standard Engineering Co.
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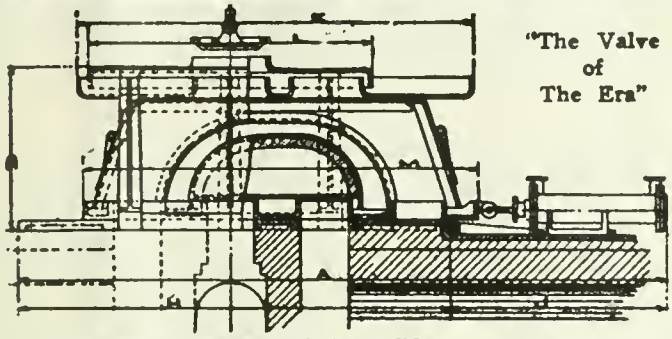

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Link-Belt Company.

Screens—Bar, Rotary or Shaking.
Link-Belt Company.

Screw Stock.
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Union Drawn Steel Co.
West Leechburg Steel Co.

Separators—Magnetic.
Cutler-Hammer Mfg. Co.

Shafting.
Heppenstall Forge & Knife Co.
Heppenstall Forge Co.
Medart Patent Pulley Co.
Standard Gauge Steel Co.
Union Drawn Steel Co.
West Leechburg Steel Co.

Shaft Couplings.
Link-Belt Co.
Smith & Serrell.

Shaft Hangers.
Medart Patent Pulley Co.

Shaking Screens.
Link-Belt Company.

Shapes—Special Steel.
Standard Gauge Steel Co.
Union Drawn Steel Co.
West Leechburg Steel Co.

Shears—Angle and Plate.
Camden Iron Works.
Canton Foundry & Machine Co.
Garrison, A., Foundry Co.
Mackintosh, Hemphill & Co.
Mesta Machine Co.
Morgan Engineering Co.
Niles-Bement-Pond Co.
Phillips & McLaren Co.
Standard Engineering Co.
Treadwell Engineering Co.
United Engineerig & Fdy. Co.

Shear Blades.
Heppenstall Forge & Knife Co.
Heppenstall Forge Co.

Shears—Billet, Bloom and Slab.
Camden Iron Works.
Canton Foundry & Machine Co.
Garrison, A., Foundry Co.
Lewis Foundry & Machine Co.
Mackintosh, Hemphill & Co.
Mesta Machine Co.
Morgan Engineering Co.
Niles-Bement-Pond Co.
Phillips & McLaren Co.
Quickwork Co.
Standard Engineering Co.
Treadwell Engineering Co.
United Engineering & Fdy. Co.
Woodard Machine Co.

Shears—Guillotine.
Canton Foundry & Machine Co.
Garrison, A., Foundry Co.
Mackintosh, Hemphill & Co.
Mesta Machine Co.
Morgan Engineering Co.
Phillips & McLaren Co.
Quickwork Co.
Standard Engineering Co.
Treadwell Engineering Co.
United Engineering & Fdy. Co.

Shear Knives.
Heppenstall Forge & Knife Co.
Heppenstall Forge Co.

Shears—Portable, Motor Driven.
Canton Foundry & Machine Co.
Garrison, A., Foundry Co.
Lewis Foundry & Machine Co.
Mackintosh, Hemphill & Co.
Mesta Machine Co.
Morgan Engineering Co
Phillips & McLaren Co.
Standard Engineering Co.
Treadwell Engineering Co.
United Engineering & Fdy Co.

Shears—Scrap, Alligator, Wire.
Camden Iron Works.
Garrison, A., Foundry Co.
Lewis Foundry & Machine Co.
Mackintosh, Hemphill & Co.
Mesta Machine Co.
Morgan Engineering Co.
Phillips & McLaren Co.
Quickwork Co.
Standard Engineering Co.
Treadwell Engineering Co.
United Engineering & Fdy. Co.
Youngstown Fdry. & Mch. Co.

Shears—Squaring.
Garrison, A., Foundry Co.
Mackintosh, Hemphill & Co.
Mesta Machine Co.
Niles-Bement-Pond Co.
Merchant & Evans Co.
Morgan Engineering Co.
Phillips & McLaren Co.
Standard Engineering Co.
Treadwell Engineering Co.
United Engineering & Fdy. Co.

Shearing Machines.
Garrison, A., Foundry Co.
Lewis Foundry & Machine Co.
Mackintosh, Hemphill & Co.
Mesta Machine Co.
Morgan Engineering Co.
Phillips & McLaren Co.
Standard Engineering Co.
Treadwell Engineering Co.

Sheet Packing—Red Fiber.
Johns-Pratt Co., The.

Sheets—Steel and Iron.
Otis Steel Co.
Merchant & Evans Co.
Youngstown Sheet & Tube Co.

Signs.
Federal Sign System.

Silent Chain Drives.
Link-Belt Company.
Morse Chain Co.

Sirens.
Federal Sign System.

Silica Brick.
American Refractories Co.
Harbison-Walker Refract. Co.

Silica Clays.
Harbison-Walker Refract. Co.

Silicon.
Davison Co., Allen S.
McKeefrey & Co.
United States Alloys Corp.

Silicon—Ferro.
United States Alloys Corp.

Skip Hoists.
Link-Belt Company.
Treadwell Engineering Co.

Skip Cars.
Atlas Car & Mfg. Co.
Biehl Iron Works, Inc.
Easton Car & Construction Co.
Youngstown Fdy. & Mch. Co.

Slag Cutter.
Rivet Cutting Gun Co.

Sleeves and Nozzles.
Bessemer Brick Co.
Courtney Fire Brick Co.
Pittsburgh Coal Co.
Manown Manufacturing Co.

Sluice Gates.
Chapman Valve Mfg. Co., The.

Smoke Stacks—Steel.
Treadwell Construction Co.

Soaking Pit Covers.
Treadwell Engineering Co.
Wheeling Mold & Foundry Co

Solder.
Damascus Bronze Co.
Keystone Bronze Co.

Solderless Connectors—Frankel.
Westinghouse Electric & Mfg. Co.

Spares—Open Hearth.
Biehl Iron Works, Inc.

Special Machinery.
Treadwell Engineering Co.

Spindles—Mill.
American Steel Foundries.
Birdsboro Steel Fdy. & Mch. Co.
Mackintosh, Hemphill & Co.
Mesta Machine Co.
Pittsburgh Rolls Corporation.
Standard Engineering Co.
Treadwell Engineering Co.
United Engineering & Fdy. Co.
Wheeling Mold & Foundry Co.

Spray Nozzles.
Spray Engineering Co.
Schutte & Koerting Co.
Yarnall-Waring Co

Spray Cooling.
Spray Engineering Co.
Yarnall-Waring Co.

Spray Water Cooling Equipment.
Badger, E. B., & Sons Co.
Yarnall-Waring Co.

Spray Air Washing Equipment.
Badger, E. B., & Sons Co.

Sprocket Wheels.
Link-Belt Company.
Medart Patent Pulley Co.
Morse Chain Co.

Sprue Plates.
Valley Mould & Iron Corp.

Stacks—Steel.
Blaw-Knox Co.
Meehan Boiler & Constr. Co.

Steam Packing.
Crane Packing Co.

Stampings—Steel.
West Leechburg Steel Co.

Standings — Water Cooled for Rolling Mill.
Blaw-Knox Co.

Standpipes.
Blaw-Knox Co.

Steam Superheaters.
Babcock & Wilcox Co.

Steam and Storage Steam Locomotives.
Porter, H. K. Co.

Steam Specialties.
Nicholson, W. H. & Co.
Yarnall-Waring Co.

Steam Traps.
Homestead Valve Mfg. Co.
Nicholson, W. H. & Co.

Steel—Building and Structural.
Kratzer, W. N. & Co.
Mt. Vernon Bridge Co.
Toledo Bridge & Crane Co.

Steel—Cold Rolled Strip.
Mt. Vernon Bridge Co.
Standard Gauge Steel Co.
Union Drawn Steel Co.
West Leechsburg Steel Co.

Steel Frame Buildings.
Mt. Vernon Bridge Co.

Steel—Lap Weld.
American Tube & Pipe Bending Co.

Steel—Nickel.
Otis Steel Co., The

Steel Plants.
McKee, Arthur G. & Co.

Steel—Seamless.
American Tube & Pipe Band. Co.

Steel—Stamping and Drawing.
Mt. Vernon Bridge Co.
Standard Gauge Steel Co.
Union Drawn Steel Co.
West Leechburg Steel Co.

Steel Plate Work.
Graver Corp.

Steel Plate Construction—Heavy.
Treadwell Construction Co.

Steel—Structural.
Camden Iron Works.
Kratzer, W. N. & Co
Mt. Vernon Bridge Co.

Steel—Basic Open Hearth.
Brier Hill Steel Co.

Steel Plate Products—Pressed.
Meehan Boiler & Constr. Co.
Treadwell Construction Co.

Stills.
Blaw-Knox Co.

Stills for Oil Refineries.
Treadwell Construction Co.

Stokers.
Babcock & Wilcox Co., The.
Combustion Eng. Corp.
Hagan, Geo. J. Co.
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Sanford Riley Stoker Co.
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Stoker Control System.
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Stop and Check Valves.
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Stops—Automatic.
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Cutler-Hammer Mfg. Co.
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Storage Bins.
McKee, Arthur G. & Co.

Storage and Distributing Systems.
Bowser & Co., S. F.

Stoves—Hot Blast.
Blaw-Knox Co.
Mt. Vernon Bridge Co.
McClure, G. W., Son & Co.
Arthur G. McKee Co.
Smythe, S. R. Co.

Straightening Machines.
Medart Patent Pulley Co.
Morgan Construction Co.
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Treadwell Engineering Co.
Shuster, F. B. Co.

Sugar Refineries.
Treadwell Construction Co.

Superheat Cement.
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Switchboards—For Cranes.
Cutler-Hammer Mfg. Co.
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Switches—Automatic Float, Knife, Snap.
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Switches—Magnetic.
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Switches—Track.
Easton Car & Construction Co.

Tables—Rolling Mill.
Birdsboro Steel Fdy. & Mch. Co.
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Mesta Machine Co.
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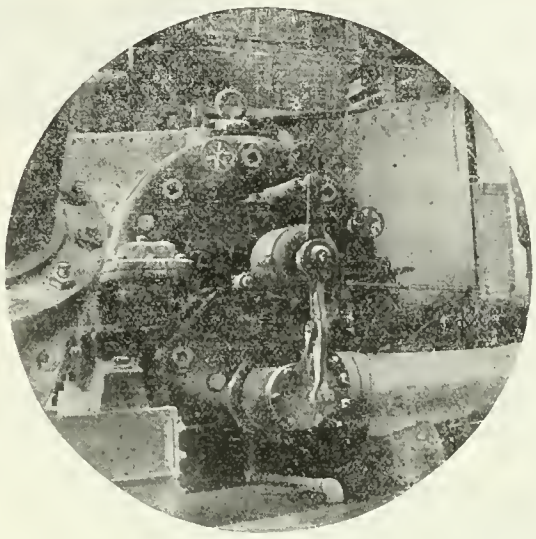

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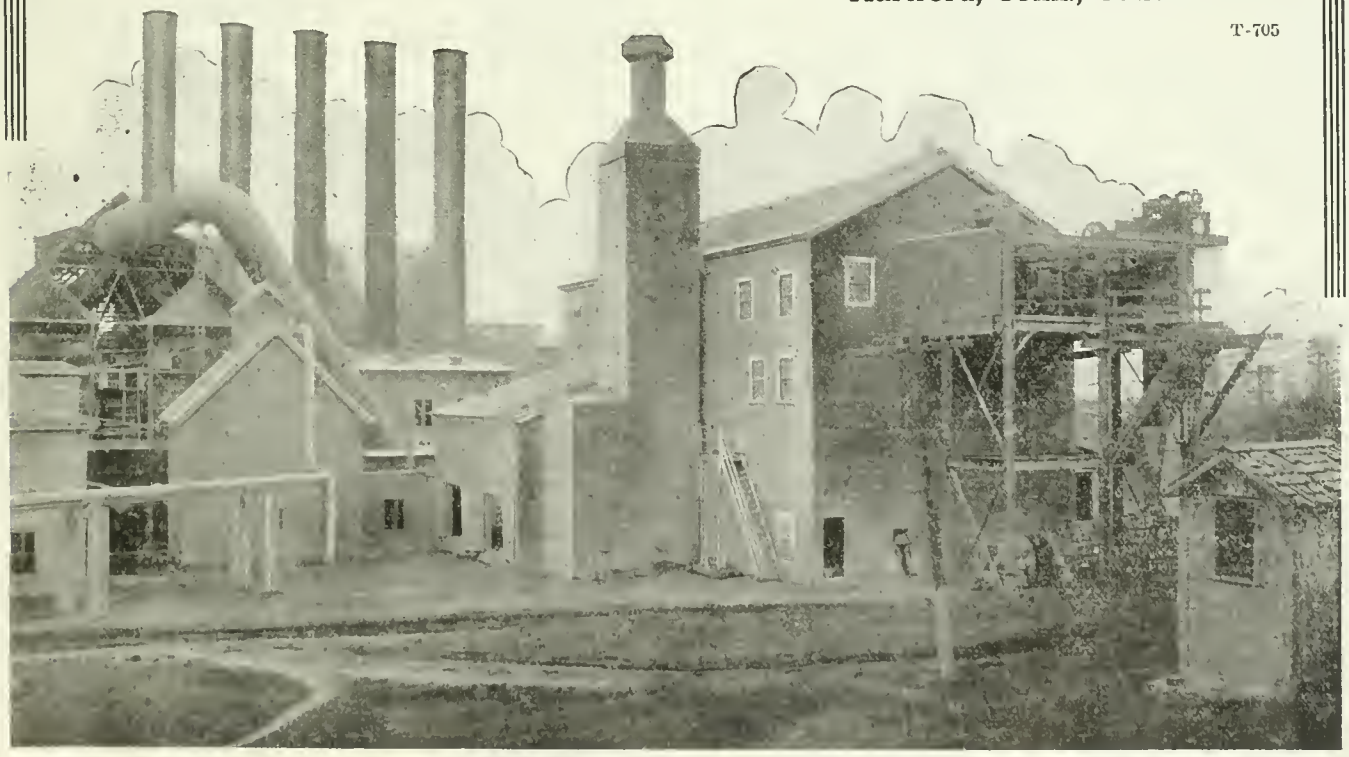
T-705



THE TERRY TURBINE

The Buyers' Guide

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Biehl Iron Works, Inc.
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International Oxygen Co.

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Smith Gas Engineering Co.

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Bristol Co., The
Riehle Bros. Testing Mch. Co.

Thermit.
Metal & Thermit Corp.

Thermometers—Recording.
Bristol Co., The
Leeds & Northrup Co.

Tile—Locomotive.
Dover Fire Brick Co.

Tin Plate Mill Equipment.
Treadwell Engineering Co.

Tipples—Coal.
Blaw-Knox Co.
Link-Belt Company.
Mt. Vernon Bridge Co.

Titanium.
Metal & Thermit Corp.

Tools.
Biehl Iron Works, Inc.
Camden Iron Works.

Tools—Hydraulic.
Camden Iron Works.

Tools—Roll Turning.
Garrison, A., Foundry Co.
Heppenstall Forge & Knife Co.
National Roll & Foundry Co.
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Pittsburgh Rolls Corporation.
Treadwell Engineering Co.
Standard Engineering Co.

Tools—Pneumatic.
Ingersoll-Rand Co.
Independent Pneumatic Tool Co.

Tools—Electric.
Independent Pneumatic Tool Co.

Towers—Transmission, Galvanized
Kratzer, W. N. & Co.

Transformers.
Pittsburgh Transformer Co.

Transfer Tables.
Whiting Foundry Equipment Co

Transmission—Rope.
Link-Belt Company.
Medart Patent Pulley Co.
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Link-Belt Company.
Mesta Machine Co.
Morse Chain Co.
United Eng. & Foundry Co.

Transmission—Silent Chain.
Chain Belt Co.
Link Belt Company.
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Transmission—Towers.
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Biehl Iron Works, Inc.
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Penn Foundry & Mfg. Co.
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Trusses—Roof.
Kratzer, W. N. & Co.
Mt. Vernon Bridge Co.

Tube Cleaners.
Combustion Eng. Co.

Tubes.
American Tube & Pipe Bend. Co.
Youngstown Sheet & Tube Co.

Tubes—Boiler, Superheater.
Youngstown Sheet & Tube Co.

Tumbling Barrels.
Babcock & Wilcox Co., The.
Whiting Foundry Equipment Co.

Tungsten.
Metal & Thermit Corp.

Turbines—Steam.
Allis-Chalmers Mfg. Co.
De Laval Steam Turbine Co.
General Electric Co.
Terry Steam Turbine Co.
Westinghouse Electric & Mfg. Co

Turbines—Power.
De Laval Steam Turbine Co.

Turbo—Blowers and Compressors.
De Laval Steam Turbine Co.
Ingersoll-Rand Co.

Turbo—Generators.
De Laval Steam Turbine Co.
Ingersoll-Rand Co.
Westinghouse Electric & Mfg. Co.

Turntables.
Easton Car & Construction Co.
Link-Belt Company.
Toledo Bridge & Crane Co.
Whiting Foundry Equipment Co

Under-Feed Stokers.
Murphy Iron Works
Sanford-Riley Stoker Co

Unions.
McCarthy, Felix.
Homestead Valve Mfg. Co.
Youngstown Sheet & Tube Co.

Vacuum and Draft Gauges.
Bristol Co.

Valves.
American Fdy. & Const'n. Co.
Blair Engineering Co.
Blaw-Knox Co.
Chapman Valve Mfg. Co., The.
Camden Iron Works.
McCarthy, Felix.
Homestead Valve Mfg. Co.
Pittsburgh Valve, Fdy. & Con. Co.
Rockwell, W. S. Co.
Richardson-Phenix Co.
Smythe, S. H. Co.
Spray Engineering Co.
Yarnall-Waring Co.

Valves—Blow-Off.
Homestead Valve Mfg. Co
Yarnall-Waring Co.

Valves—Chuck.
Chapman Valve Mfg. Co., The.

Valves—Cast Steel.
Homestead Valve Mfg. Co
Yarnall-Waring Co.

Valves—Gas.
Chapman Valve Mfg. Co., The.

Valves—Hydraulic.
Camden Iron Works.
Chapman Valve Mfg. Co., The.
Homestead Valve Mfg. Co.
Spray Engineering Co
Yarnall-Waring Co.

Valves—Special.
Pittsburgh Valve, Fdy. & Con. Co.

Valves—Stud, Gas Cylinder.
International Oxygen Co.
Spray Engineering Co.
Yarnall-Waring Co.

Valves—Hydraulically Operated.
Chapman Valve Mfg. Co., The.

Valves and Fittings—Hydraulic.
Chambersburg Engineering Co.
McCarthy, Felix.
Homestead Valve Mfg. Co.
Pittsburgh Valve, Fdy. & Con. Co.
Spray Engineering Co.
Yarnall-Waring Co.

Valves—Motor-Operated.
Chapman Valve Mfg. Co., The.
Spray Engineering Co.
Yarnall-Waring Co.

Valves—Regrinding.
McCarthy, Felix.
Homestead Valve Mfg. Co.

Ventilators.
Merchant & Evans Co.
Schutte & Koerting Co.

Wash—Core, Mold.
Quigley Furnace Specialties Co.
United States Graphite Co., The

Washers.
Oliver Iron & Steel Co.
Schutte & Koerting Co.

Water Coolers.
The Jewett Refrigerating Co

Water Cooling—Apparatus.
Spray Engineering Co.
Yarnall-Waring Co.

Water Filters.
Graver Corp.
Scaife, Wm. B. & Sons Co.

Water Heaters.
Graver Corp.

Water Softening and Purifying Systems.
Scaife, Wm. B. & Sons Co.

Water—Intake Screens—Traveling
Chain Belt Co.
Link-Belt Company.

Water Purifier.
Yarnall-Waring Co.

Water Tube Steam Boilers.
Babcock & Wilcox Co., The.
Wickes Brothers C

Wedges.
Oliver Iron & Steel Co.

Welded Specialties and Headers.
Blow-Knox Co.
Pittsburgh Valve, Fdy. & Con. Co

Welding and Cutting Apparatus—Oxy-Hydrogen.
International Oxygen Co.

Welding.
Blaw-Knox Co.
Metal & Thermit Corp.
Pittsburgh Metal Brazing Co.

Welding—Thermit.
Metal & Thermit Corp.

Wheels.
Atlas Car & Mfg. Co.
Easton Car & Construction Co
Fuller-Lehigh Co.
Link-Belt Company.
Treadwell Engineering Co.

Wheels—Car.
Easton Car & Construction Co.
Fuller-Lehigh Co.
Treadwell Engineering Co.

Wheels—Fly.
Link-Belt Company.
Mesta Machine Co.
United Engineering & Fdy. Co.

Wheels—Sheave.
Link-Belt Company.
Mesta Machine Co.

Wheels—Sprocket or Traction.
Link-Belt Company.
Morse Chain Co.

Wheels—Steel.
American Steel Foundries.

Wire Rope Shield.
Ironsides Co., The.

Wire Mill Equipment.
American Ind. Eng. Co.

Wire Straightening Machines.
American Industrial Eng. Co.
Medart Patent Pulley Co.
Morgan Construction Co.
Niles-Bement-Pond Co.
Shuster Co., F. R.

Wrought Iron Pipe.
Reading Iron Co.

Co-operate:—Refer to The Blast Furnace and Steel Plant

Index to Advertisers.

A

Addy Co., The Matthew 100
Allan & Son, A..... 15
Alliance Machine Co., The..... 422-A-113
Allis-Chalmers Mfg. Co..... 35
Aluminum Co. of America..... 115
American Crucible Prod. Co..... 425-A
American Enameled Brick & Tile Co.... 109
American Industrial Eng. Co..... 113
American Refractories Co..... 111
American Roller Bearing Co..... 115
American Steel Foundries..... 23
American Tube & Pipe Bending Co..... 113
Ashland Fire Brick Co..... 427-A

B

Babcock & Wilcox Co..... 88
Bacharach Industrial Instrument Co... 115
Badger & Sons, Co., E. B..... 102
Beaumont, R. H., Co..... 13
Bessemer Brick Co..... 111
Biehl Iron Works, Inc..... 107
Birdsboro Steel Fdy. & Mach. Co..... 21
Blair Engineering Co..... 113
Blaw-Knox Co., The..... 78
Bowser, S. F. Co..... 96
Brier Hill Steel Co..... 95
Bristol Co., The 57
Brosius, Edgar E..... 113
Browning & Co., Victor R..... 113

C

Calorizing Corporation of America..... 52
Canton Foundry & Machine Co..... 115
Camden Iron Works 95
Celite Products Co..... 109
Chambersburg Engineering Co..... 113
Champion Engineering Co..... 77
Chapman Engineering Co..... 34
Chapman Valve Maunfacturing Co..... 41
Classified Section 80-81
Clark Car Co. .....Inside Front Cover
Cleveland Cliffs Iron Co..... 55
Clinton Metallic Paint Co..... 107
Combustion Eng. Corp..... 51
Courtney Fire Brick Co..... 109
Crane Packing Co. 89
Crescent Refractories Co..... 111
Cutler-Hammer Mfg. Co..... 53

D

Damascus Bronze Co. 431-A
DeLaval Steam Turbine Co..... 91
Detrick, M. H., Co..... 28
Diamond Power Specialty Co..... 90
Dover Fire Brick Co..... 111
Duff, Samuel 117
Duquesne Steel Foundry Co..... 105

E

Easton Car & Construction Co..... 428-A
Edward Valve & Mfg. Co..... 47
Economy Fuse & Mfg. Co..... 82
Electric Controller & Mfg. Co., The Back Cover
Electric Furnace Construction Co..... 99
Ellis, Frank I. 117
Engineer Co., The 38
Eureka Fire Brick Works 109

F

Falk Company 32
Fawcus Machine Co. 113
Freyn, Brassert & Co..... 117
Fuller-Lehigh Co. 102
Fuller Engineering Co. 117

G

Garrison Foundry Co., A..... 24
General Briquetting Co.....Front Cover
General Electric Co. 64
Graver Corp. 33
Gulf Refining Co. 9
Green Fuel Economizing Co..... 101
Greene, Tweed & Co. 86

H

Hagan, Geo. J. Co..... 115
Hamilton & Hansell, Inc..... 115
Harbison-Walker Refractories Co..... 109
Hays, Jos. W., Corp..... 87
Hays School of Combustion..... 424-A
Heppenstall Forge & Knife Co..... 104
Homestead Valve Manufacturing Co..... 10
Hommel & Co., Ludwig..... 113
Hope Engineering Co..... 92
Hyatt Roller Bearing Co..... 4-5-48-49
Hydraulic Press Brick Co..... 107

I

Independent Pneumatic Tool Co..... 79
Ingersoll-Rand Co..... 43
Ingram & Sons, H. C..... 109
International Oxygen Co..... 96
Ironsides Co., The 29

J

Johns-Manville Co. 56

K

Kellogg, M. W. Co..... 97
Keystone Bronze Co. 30
Keystone Lubricating Co. 6-7
Kier Fire Brick Co. 111
King-Karbo Products Corp..... 111
Koppers Co., The 430-A
Kratzer, W. N. Co..... 115

L

Ladd, Geo. T. Co..... 91
Laughlin, Alex. & Co..... 117
Leeds & Northrup Co..... 55
Lewis Foundry & Machine Co..... 20
Link-Belt Company 37
Lubricating Metal Co. 12

M

Mackintosh, Hemphill & Co..... 423-A
Manown Manufacturing Co..... 111
Meade & Co., Richard K..... 115
Medart Patent Pulley Co..... 429-A
Meehan Boiler & Construction Co..... 88
Mesta Machine Co. 25-426-A
Metal & Thermit Corporation..... 50
Mine Safety Appliances Co..... 98
Mires Fuel Oil Equip. Co..... 44
Moore, W. E. & Co..... 117
Morgan Construction Co., The..... 16-17-18
Morgan Engineering Co., The..... 66
Morse Chain Co. 31
Murphy Iron Works 58
Mutton Hollow Fire Brick Co..... 111
Mount Union Refractories Co..... 111
Mount Vernon Bridge Co., The..... 104

Mc

McLain's System, Inc. 107
McClure, G. W., Sons Co..... 117
McCarthy, Felix 88
McFeely Brick Co. 109
McKee & Co., Arthur G..... 36
McKeefrey & Co..... 115

N

National Roll & Foundry Co..... 27
Nicholson, W. H. & Co..... 115
Niles-Bement-Pond Co. 46
Northern Engineering Works 113
Nuttall, R. D. Co..... 103

O

Ohio Electric & Controller Co.....
.....Inside Back Cover
Orton & Steinbrenner Co..... 100
Otis Steel Co., The 93

P

Paterson Fire Brick Co..... 107
Penn Foundry & Manufacturing Co.... 107
Pennsylvania Crusher Co. 100
Phillips & McLaren 107
Phoenix Rolls Corp. 105
Pittsburgh Coal Co. 111
Pittsburgh Electric Furnace Corp..... 103
Pittsburgh Furnace Co..... 101
Pittsburgh Rolls Corp. 105

P

Pittsburgh Iron & Steel Foundries..... 19
Pittsburgh Metal Brazing Co..... 113
Pittsburgh Piping & Equipment Co..... 60
Pittsburgh Saw & Mfg. Co..... 92
Pittsburgh Transformer Co..... 115
Pittsburgh Valve, Foundry & Construction Co. 94
Porter, H. K. Co. 79
Pyro Clay Products Co..... 111

Q

Quickwork Co., The 105
Quigley Furnace Specialty Co. 102-109

R

Reading Iron Co. 61
Republic Flow Meter Co..... 84
Riehle Bros. Testing Machine..... 100
Rivet Cutting Gun Co. 82
Robinson Sons Co., Dwight P..... 117
Rockwell, W. S. Co..... 100-101

S

Sanford Riley Stoker Co..... 85
Scaife Co., Wm. B. 115
Seaman-Sleeth Co. (Pgh. Rolls Corp.).. 105
Sharon Fire Brick Co. 109
Shover, B. R. 117
Shuster Co., F. B..... 8
Simonds Manufacturing Co. 100
Smith Gas Engineering Co., The..... 122
Smith & Serrell 63
Smythe, S. R. Co., The..... 117
Soisson, Joseph, Fire Brick Co..... 111
Speer Carbon Co. 103
Spray Engineering Co..... 82
Stroud & Co., E. H..... 102
Stackpole Carbon Co. 102
Standard Engineering Co. 26
Standard Gauge Steel Co..... 104
Standard Scale & Supply Co..... 107
Stewart Iron Co..... 104

T

Taylor, Chas. Sons Co. 111
Taylor-Wilson Mfg. Co..... 101
Terry Steam Turbine Co..... 119
Texas Co. 54
Thwing Instrument Co. 59
Tod-Stambaugh Co. 115
Toledo Bridge & Crane Co..... 11
Treadwell Engineering Co..... 44
Trill Indicator Co. 91

U

Underfeed Stoker Co. of America..... 100
Union Drawn Steel Co. 104
United Engineering & Foundry Co..... 3
U. S. Crane Co. 113
United States Graphite Co..... 99
U. S. Reduction Co. 113

V

Valley Mould & Iron Corp..... 42
Vulcan Iron Works 97

W

Wellman-Seaver-Morgan Co..... 45
Westinghouse Electric & Mfg. Co..... 62-83
Westinghouse, Church, Kerr & Co., Inc 117
West Leechburg Steel Co..... 104
Wheeling Mould & Foundry Co..... 22
Whiting Foundry Equipment Co..... 14
Wickes Boiler Co., The 88
Wood, R. D. & Co..... 39
Woodard Machine Co. 93

Y

Yarnall-Waring Co. 92
Youngstown Foundry & Machine Co..... 105
Youngstown Sheet & Tube Co..... 115

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SUCCESSFUL CENTRAL STATION GAS PLANTS

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COLD 99.5% CLEAN GAS

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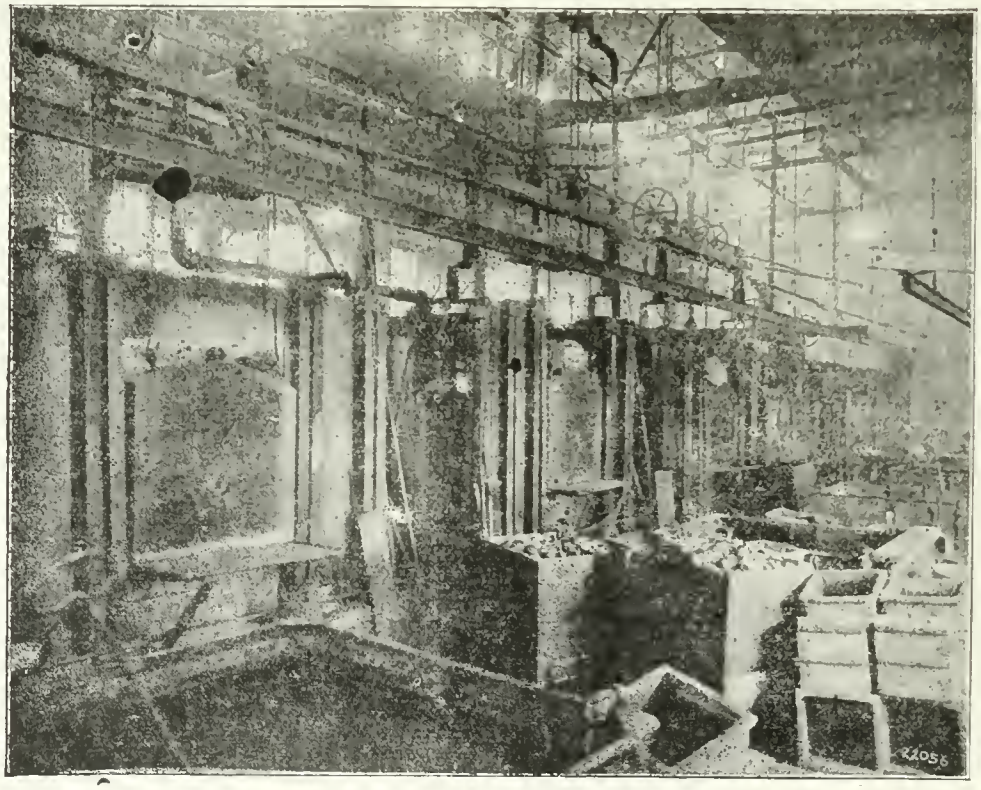

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Water Reduced to Minimum by Means of Cooling Tower
Tar Returned to the Producer and Gasified

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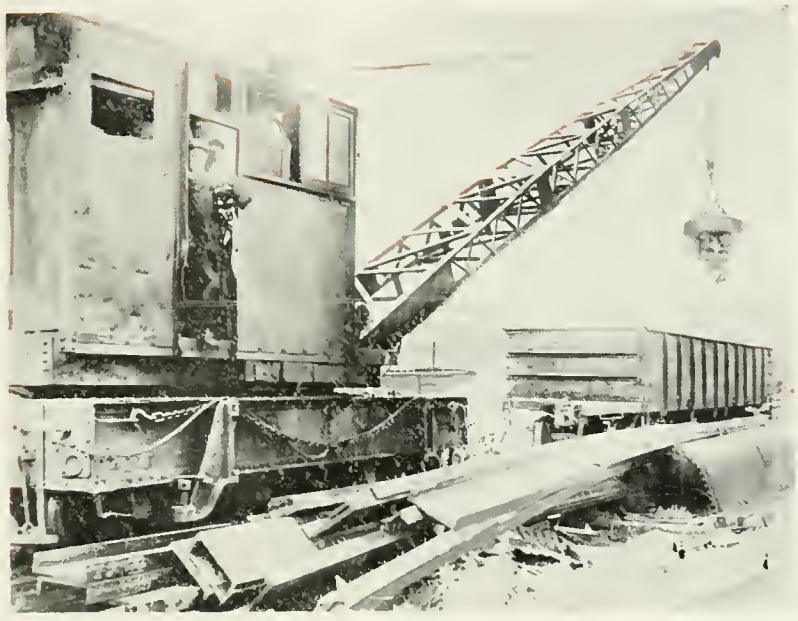
LIFTING MAGNETS



No. 5-50" Ohio Magnet at LaBelle Iron Works, Steubenville, O.

The outer ring of the Ohio Magnet has a heavy bottom section, with no through holes, which will give 10 to 20 years wear in most severe service.

The supporting bolts are on top, protected from injury and positively locked.

This construction reduces ring diameter and dead weight of magnet but gives maximum lifting capacity.

Low heat rise also helps all day lifting capacity.

Bulletin 104.

The Ohio Electric & Controller Company

5900 Maurice Ave., Cleveland, Ohio

THE MOST FAITHFUL WORKER

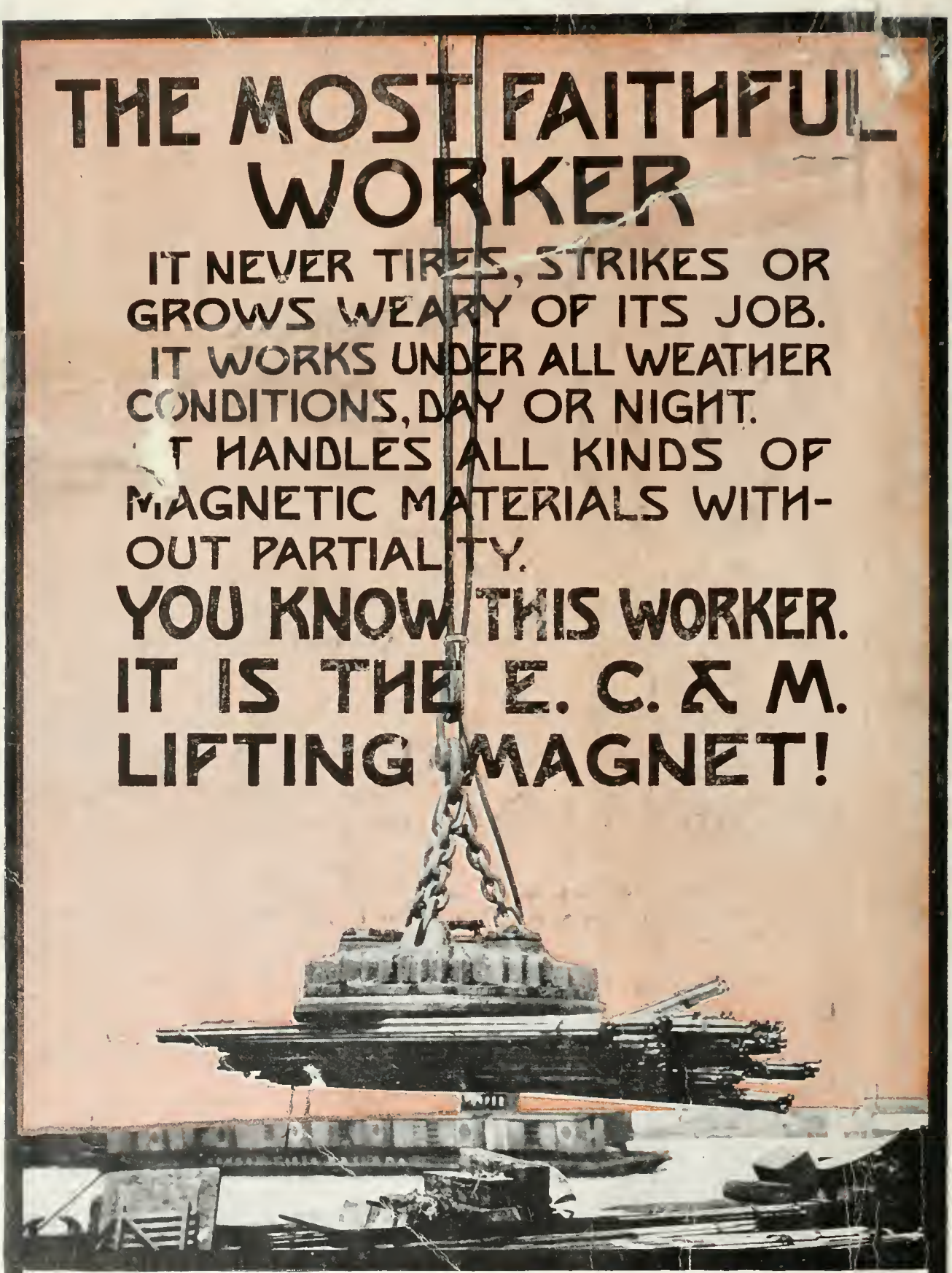
IT NEVER TIRES, STRIKES OR GROWS WEARY OF ITS JOB.

IT WORKS UNDER ALL WEATHER CONDITIONS, DAY OR NIGHT.

IT HANDLES ALL KINDS OF MAGNETIC MATERIALS WITHOUT PARTIALITY.

YOU KNOW THIS WORKER.

IT IS THE E. C. & M. LIFTING MAGNET!



THE ELECTRIC CONTROLLER & MFG. CO.

NEW YORK - 50 CHURCH ST
PITTSBURG - OLIVER BLDG.
BIRMINGHAM - BROWN-MARX BLDG
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